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1. Executive Summary

The report contains the results of research carried out under the Frontsh1p project. The aim of the research entitled: *Circular Economy Regional framework and Governance Model* is to identify best practices in order to prepare conditions for the effective management of the Circular Regional Cluster. The research focused on identifying the conditions for the functioning of the regional socio-economic ecosystem and the conditions for conducting local policy for circular development. The context of local, regional, national and EU conditions relating to institutions strengthening organizations of circular economies was taken into account. Hence, the basic research tasks have been divided into six deliveribles groups:

- Definition of the proper policy model for effective governance of the regional cluster taking into account the organizational conditions of the entrepreneurial ecosystem and the possibility of creating industrial symbios, and Legal and formal barriers for functioning CRC;
- Identification of market failures in scope of circular economy development;
- Identification of incentives and barriers of existing socioeconomic policy instruments on the regional, national and EU levels in scope of circular economy developments.
- Draft of the Public Circular Procurement scheme to be used for the CSSs planning.
- Identification of the existing system of public and private investments and Interoperability of CRC databases

The research was multi-faceted and multi-threaded. Both quantitative and qualitative research techniques were used. As a result, the implementation of the Circular Regional Cluster model was proposed based on four sectors of stakeholders: company, academy, society and government. A special role of initiation, showing good practices and coordinating the unorganized circular market was assigned to local and regional governments.

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2. About FRONTSH1P

FRONTSH1P aims at ensuring green and just transition of the Polish Łódzkie Region towards decarbonization and territorial regeneration through demonstration of four highly replicable regenerative circular systemic models and solutions that address the current challenges and needs of the Region, transforming them into opportunities for economic growth, social inclusion, decarbonisation of systems of production and consumption, improvement of the quality of life for citizens, reconnection between the urban and rural context.

Systemic problems require systemic solutions. These solutions are aimed at achieving synergistic effects for all stakeholders of a circular regional cluster (CRC) operating in the region: company, academy, society and governments. Each Circular Systemic Solutions covers the valorisation of wastes to recover energy, materials, and produce more environmentally friendly products through the implementation of innovative technologies. The waste streams involved in the project are: Wood packaging, Food, agricultural and municipal organic waste, Wastewater and Plastic and rubber waste.

FRONTSH1P involves key territorial partners and particularly the Regional Institution, Scientific establishments, representative of civil society, agricultural entrepreneurship and Industry Groups.

The involvement of those relevant actors will allow the promotion of the circular economy and to reach relevant actors, such as municipalities, companies, consumers, and civil society, which will be engaged in a participatory approach to collect needs and perceived constraints. From this activity, the cluster system will identify and define a circular economy strategy, with clear objectives, measurable targets, and a proper monitoring method. Moreover, the cluster will facilitate collaborations and co-operations among relevant actors for boosting circularity. It will mean to:

- Identify already available initiatives and policies at local, regional, national, and international level
- Create platforms to explore opportunities and to share information, best practices, and successful examples
- Activate a strong communication between universities, businesses, and civil society for the technological transfer
- Exchange information and experiences with other Regions and Countries

The project will foresee activities, such as the definition of regulatory instruments aimed at accelerating the transition to a circular economy creating a Circular Economy Action Plan (CEAP) in which the proposed systemic solution is embedded.

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3. Policy Model - Territorial Ecosystem Framework for Circular Economy in Lodzkie Region

3.1. Potential of the Lodzkie Region

The Lodzkie Region has 2,426,806 inhabitants, of which 52.4% are women, and 47.6% are men. From 2002-2021, the number of inhabitants decreased by 6.9%. The average age of the inhabitants is 43.3 years, slightly higher than the average age of the entire Polish population. The projected number of inhabitants of Łódź in 2050 is 1,999,131, of which 1,031,519 are women, and 967,612 are men (GUS – Local Data Bank, 2022).

In the Lodzkie Region, a negative natural increase is recorded, amounting to -14 916. This situation corresponds to the natural decrease of -6.09 per 1000 inhabitants of Łódź (the capital of the region). In 2020, 20,891 children were born, including 48.9% girls and 51.1% boys. The demographic dynamics index, i.e. the ratio of the number of live births to the number of deaths, is 0.58 and is much lower than the average for the entire country. In 2019, 36.3% of deaths in Łódź were caused by cardiovascular diseases, 25.1% of deaths in Łódź were caused by cancers, and respiratory diseases caused 7.9% of deaths. There are 14.62 deaths per 1000 inhabitants of Łódź. (GUS – Local Data Bank, 2022) It is much more than the average for Poland. In 2020, 19,670 registrations in internal traffic and 21,482 deregistrations were registered; as a result, the balance of internal migrations for the Lodzkie Region was -1,812. In the same year, 445 people checked in from abroad, and 305 deregistrations abroad were registered - this gives the balance of foreign migrations amounting to 140. The structure of people in Łódź voivodeship is: 58.3% of the inhabitants of Łódź have a working age, 17.1% have pre-working age, and 24.7% of the inhabitants have post-working age (however, it is necessary to take into account the current changes caused by the war in Ukraine and the significant number of refugees who they also settle in the Lodzkie Region) (GUS – Local Data Bank, 2022).

In 2020 year the urbanization rate amounted to 63.28% (Fig. 1). Łódź voivodeship consists of:

- 21 land powiats and 3 cities with powiat status (Łódź, Piotrków Trybunalski, Skierniewice),
- 177 gminas, including 18 urban, 129 rural and 30 urban-rural,
- 527 cities and 4465 villages.

The industry of the Lodzkie Region has historically been dominated by textile industry. The situation changed radically in the last decade of the twentieth century. At that time, large textile factories collapsed and the textile industry lost its dominant position. There has been an increase in the importance of the power industry, machinery, agri-food, metallurgy, pharmaceutical and construction.

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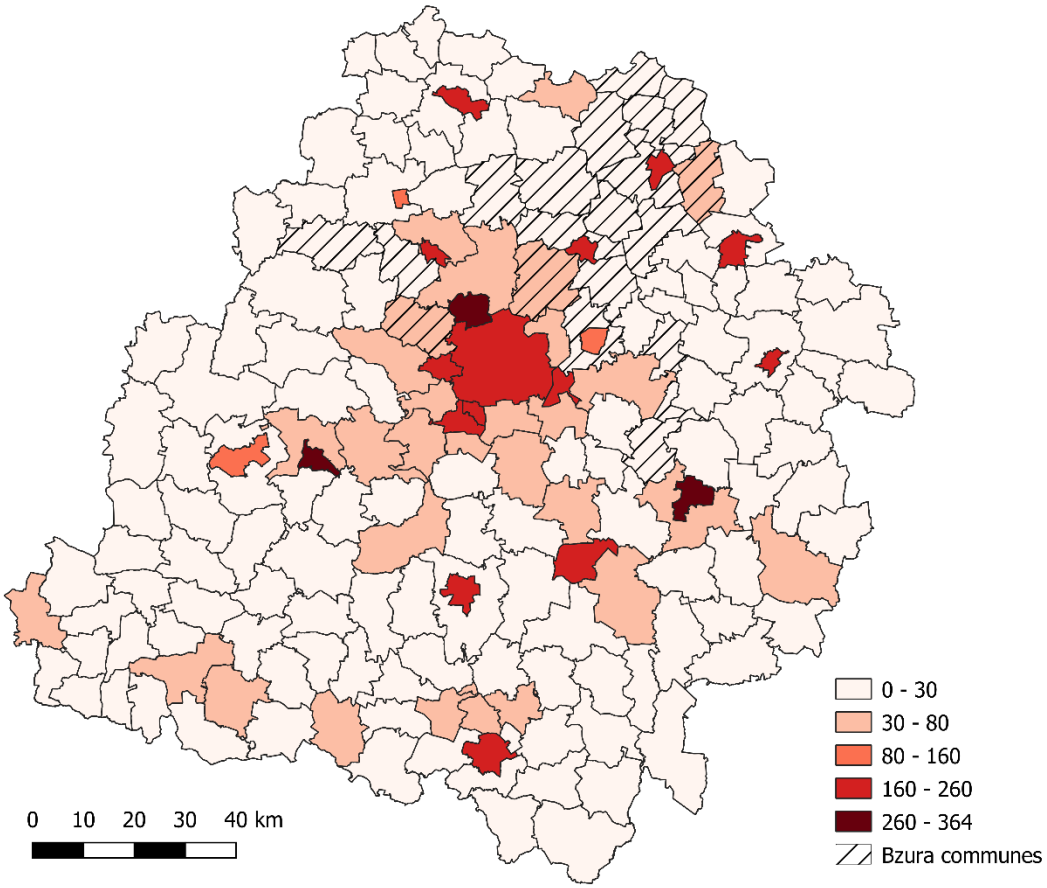
Figure 1. The density of address points on each square kilometre



Source: own work based on data from Head Office of Geodesy and Cartography (GUGiK).

There are approximately 5,800 different NGOs in the Lodz region. Most of them are registered as associations (4,100), followed by foundations (0,8). Among the NGOs, the dominant ones focus their main activities on supporting and promoting the sport, recreation, tourism and hobbies. There is also a large group of NGOs whose activities focus on culture and the arts. Compared to the whole of Poland, in the Lodz region, a relatively large proportion of NGOs operate in the area of supporting local and socio-economic development.

The transition to a circular economy requires recognizing local indicators/factors that are key to developing a strategy for implementing a place-based circular economy. Key indicators for CE implementation include domestic material extraction of natural resources. This indicator shows that economies with the availability of natural resources, specialized in the first and second sectors, have an advantage in implementing CE. In the Lodz region, this indicator is high at over 30 tonnes per capita (Figure 2). The most significant is the lignite deposits near Belchatow. The Belchatow lignite mine covers about half of the country's demand for this raw material. So, despite, the high value of the analysed indicator, its structure is therefore unfavourable, because it is formed mainly by non-renewable resources. Lignite mining also negatively affects the natural environment and its other resources (e.g., the water table is lowered). Thus, the availability of other natural resources is reduced.

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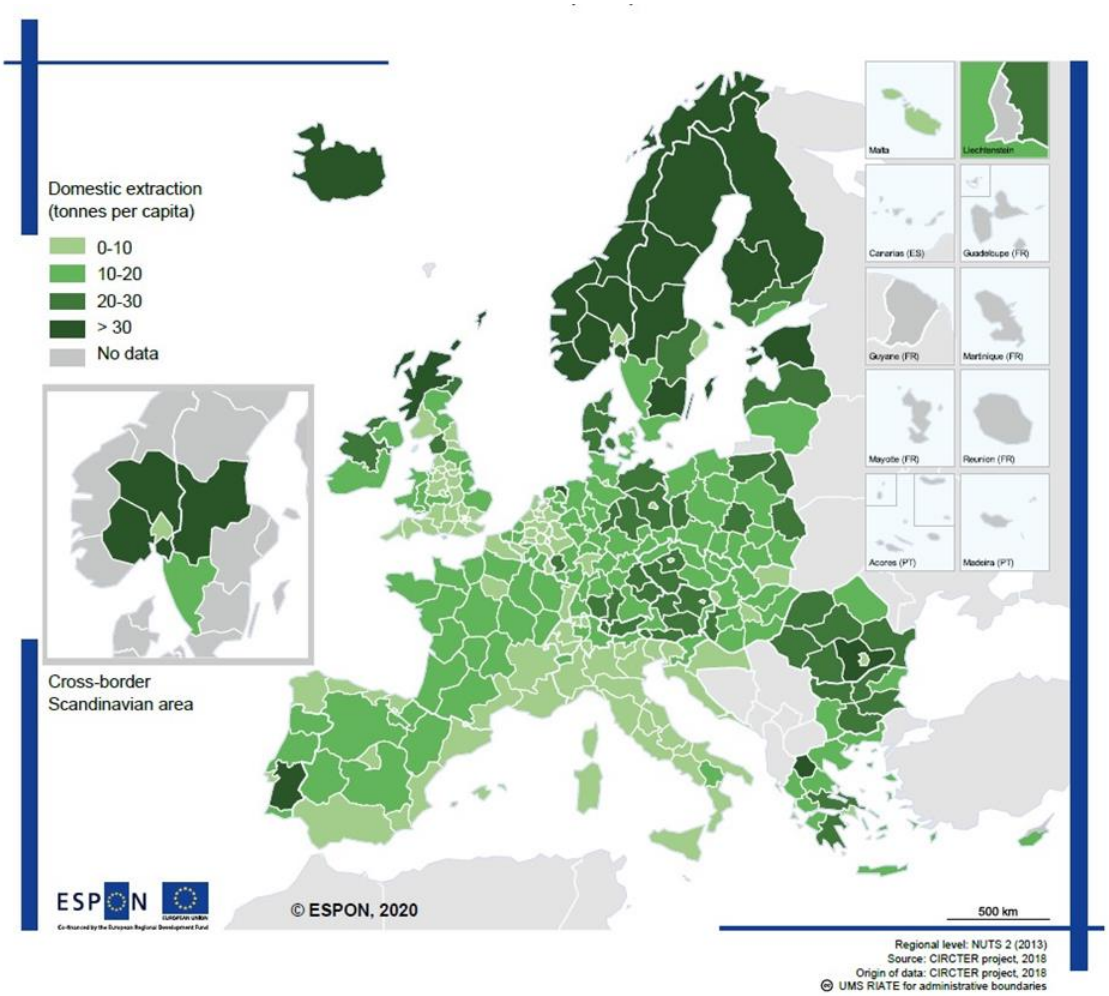
Figure 2. Domestic extraction of natural resources (2014)



Source: Van Herwijnen M., Bianchi M., Cordella M., Menger P., POLICY BRIEF: A territorial approach to transitioning towards a circular, ESPON 2020, Published in February 2022, p. 5.

Another important indicator of the circular economy is the generation of waste relative to the domestic consumption of materials. Combining these two figures makes it possible to assess the overall efficiency of production and consumption systems. This indicator provides information on the relative intensity of raw material consumption and waste generation 'pressures' of an economy. In Lodz Region, this indicator is high at 7-10% (Figure 3). It shows that Lodz Region is moving towards circular systems, for example by increasing the recycling rate. Overall it indicates that waste management in Lodz Region is conducted in an appropriate way, although it needs to be improved.

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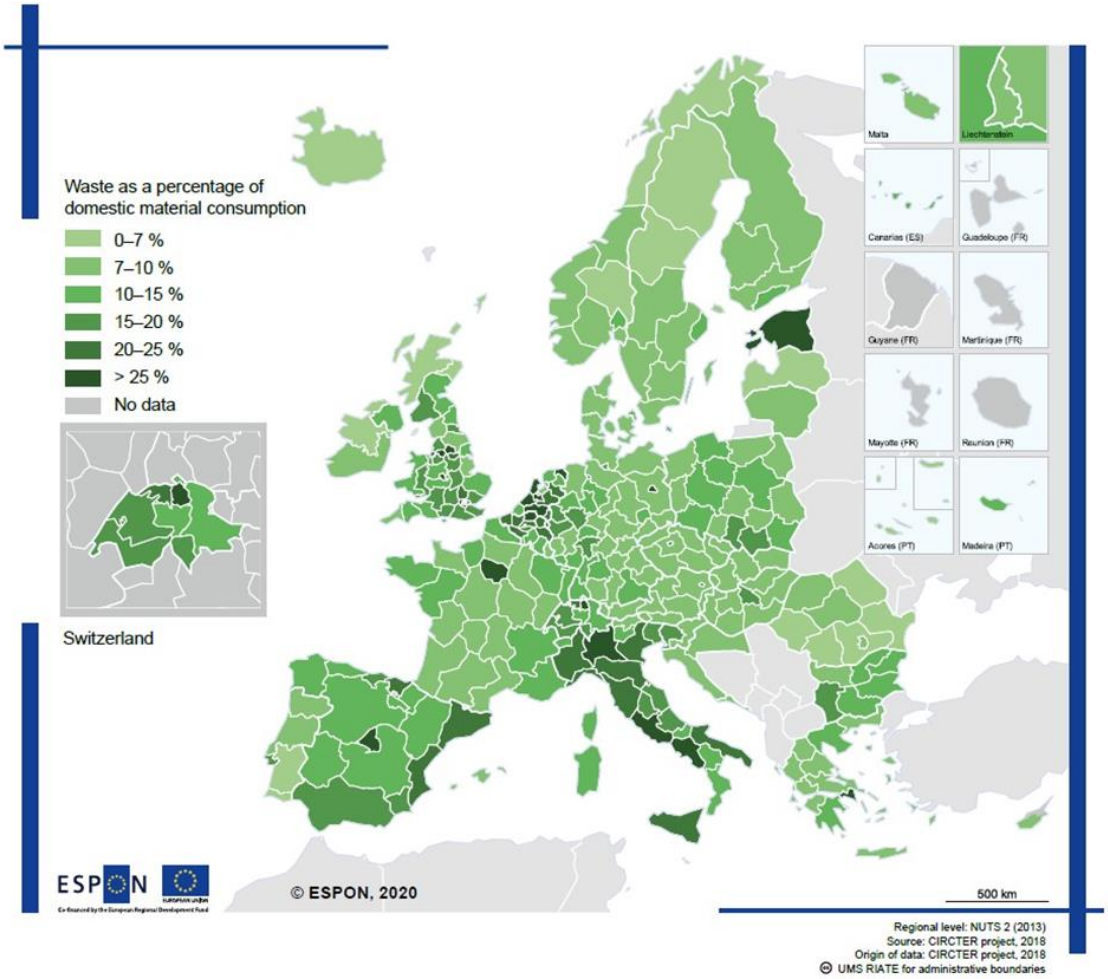
Figure 3. Generation of waste (excluding major mineral waste) as a proportion of domestic material consumption (2014)



Source: Van Herwijnen M., Bianchi M., Cordella M., Menger P., POLICY BRIEF: A territorial approach to transitioning towards a circular, ESPON 2020, Published in February 2022, p. 7.

An analysis of circular economy business activity, expressed in terms of employment generated or financial turnover, is key to identifying circular systems in a region. In the case of the Lodz region, the turnover generated by circular enterprises is very low, ranging between 0 and 50,000 euros per year (Figure 4). This indicates that the Lodz region is not one of the most innovative in Europe or even in Poland. The number of circular economy initiatives in the Lodz Region needs to be improved.

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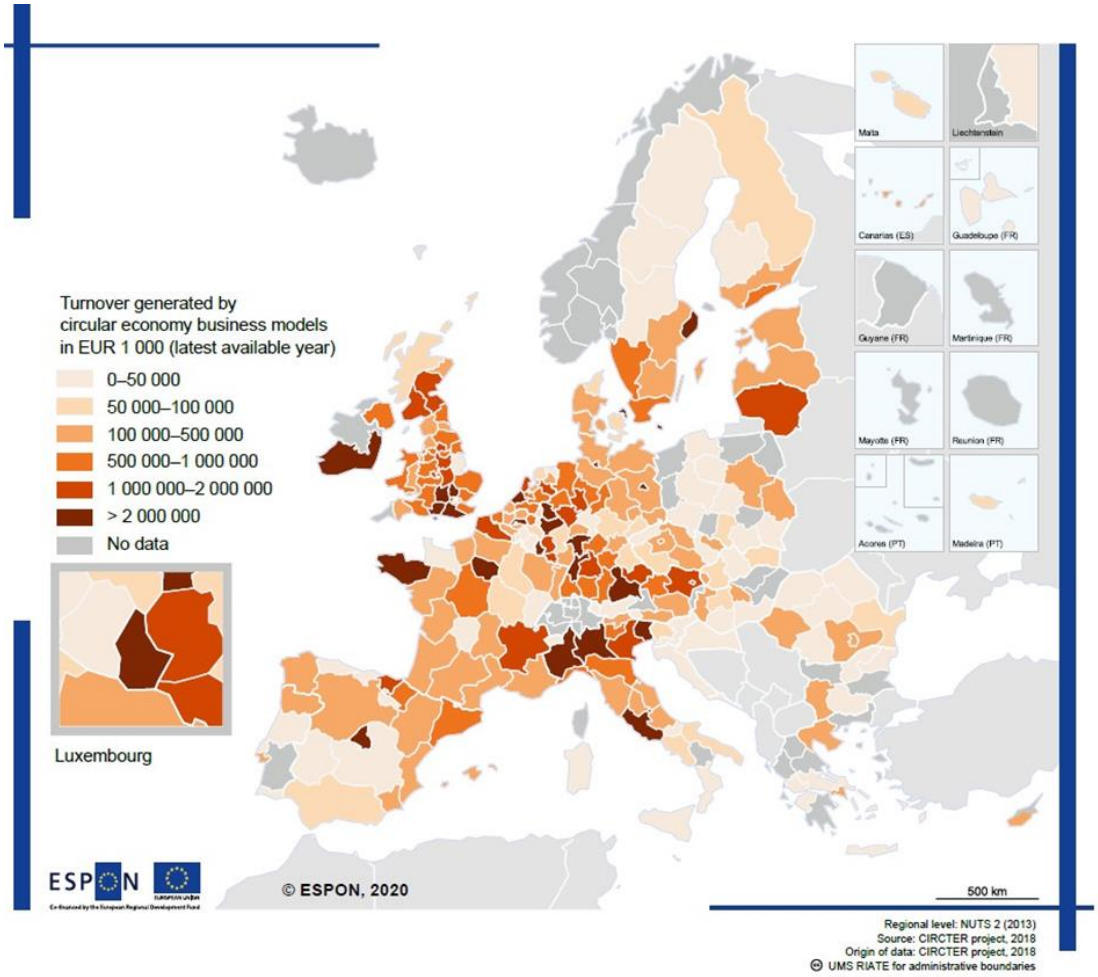
Figure 4. Turnover generated by companies associated with circular economy business models



Source: Van Herwijnen M., Bianchi M., Cordella M., Menger P., POLICY BRIEF: A territorial approach to transitioning towards a circular, ESPON 2020, Published in February 2022, p. 8.

In conclusion, the implementation of circular economy solutions in the Lodz Voivodeship stands at a fairly good level. This is shown by the analyzed indicators: Domestic extraction of natural resources (2014) and Generation of waste (excluding major mineral waste) as a proportion of domestic material consumption (2014). An indicator that should be improved in the Lodz region is the turnover that CE companies bring in. Challenges in the implementation of CE arise primarily at the local level and concern the closing of circular value chains. It is also a challenge to monitor the situation at the local and regional level with regard to the implementation of CE solutions, as well as the achievement of sustainable development goals.

The region's fairly good situation is, among other things, the result of activities undertaken at the national level. Poland, as a member of the UN, is implementing the assumptions of the document "Transforming Our World: Agenda for Sustainable Development - 2030". The document "Transforming Our World: Agenda for Sustainable Development - 2030" established by UN member states sets 17 Sustainable Development Goals. To each of the goals are assigned tasks, the implementation of which

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is monitored through indicators at the global, regional and national levels. The goals set are extensive, as they address coherent elements of sustainable development: economic growth, social inclusiveness and environmental protection.

Table 1 contains selected indicators of sustainable development relating mainly to economic growth and circular economy, which are relevant to achieving the goals of the Frontsh1p project. The dynamics of changes in the indicators over the 10-year period show that Poland's efforts to achieve the Sustainable Development Goals are giving positive results. In each of the analyzed goals, actions were taken to achieve them. These activities produce positive results, as confirmed by the analyzed indicators - most of them have improved. Only the speed of the introduced changes may raise objections. Given the time limit for the implementation of the Sustainable Development Goals (2030), the pace of their implementation should accelerate.

Table 1. Selected indicators of sustainable development relating to circular economy in Poland in years: 2010, 2015, 2020.

Goal CDG	Goal SDG for Poland	Indicator (units)	2010	2015	2020
Goal 1. No poverty	Increasing the activation of socially excluded people, including through the development of the social economy sector	1.2.a Number of social integration centers, professional activity establishments and occupational therapy workshops per 100,000 population (pieces)	-	2,4	2,7
	Increasing the activation of socially excluded people, including through the development of the social economy sector	1.2.b Number of participants in social integration centers, professional activity institutions and occupational therapy workshops per 100,000 population (persons)	-	101,6	115,1
Goal 2. Zero hunger	Support for structural transformations ensuring an increase in the competitiveness of agriculture, including an increase in the competitiveness of farms and agri-food producers	2.1.a The agricultural government expenditure index (AOI)	0,58	0,37	0,45
	Support for structural transformations ensuring an increase in the competitiveness of agriculture, including an increase in the competitiveness of farms and agri-food producers	2.1.b R&D expenditure in the field of agriculture in relation to GDP (%)	0,06	0,05	0,06
	Ensuring food quality and safety as well as the country's food safety, taking into account environmental requirements	2.2.a Share of certified organic agricultural area on organic farms in total agricultural area in agricultural holdings (%)	2,07	3,45	2,68
Goal 6. Clean water and sanitatione	Creation of legal and financial mechanisms favoring the rational use of water resources and the implementation of water-saving technologies, as well as the construction and modernization of sewage treatment plants	6.2.a Percentage of population using sewage treatment plants (total, percentage%)	64,7	72,7	74,8
	Creation of legal and financial mechanisms favoring the rational use of water resources and the implementation of water-saving technologies, as well as the construction and modernization of sewage treatment plants	6.2.a Percentage of population using sewage treatment plants (in the city, %)	88,0	94,6	94,7
	Creation of legal and financial mechanisms favoring the rational use of water resources and the implementation of water-saving technologies, as well as the construction and modernization of sewage treatment plants	6.2.a Percentage of the population using sewage treatment plants (in rural areas, %)	28,5	39,6	45,2
	Creation of legal and financial mechanisms favoring the rational use of water resources and the implementation of water-saving technologies, as well as the construction and modernization of sewage treatment plants	6.2.b Industrial and municipal wastewater treated biologically, chemically and with increased removal of biogens in% of wastewater requiring treatment (%)	65,73	70,90	73,32
Goal 7. Affordable and clean energy	Improving energy efficiency	7.1.a Primary intensity of GDP with climatic correction (kg / euro (in constant 2005 prices)	0,318	0,272	0,251

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	Creating conditions for the constant and sustainable development of the energy sector; reducing the impact of the energy industry on the environment	7.2.a Share of renewable energy in gross final energy consumption (%)	9,28	11,88	16,10
	Ensuring the energy security of the state	7.3.a Ratio of total energy production to global energy consumption (%)	66	71	56
Goal 8. Decent work and economic growth	Searching for new competitive advantages based on the technological advancement of products, quality and innovation of the offered products, as well as mechanisms of internationalization of enterprises	8.1.a Share of high-tech exports in total exports (%)	6,0	8,5	9,0
	Searching for new competitive advantages based on the technological advancement of products, quality and innovation of the offered products, as well as mechanisms of internationalization of enterprises	8.1.b Outlays on innovative activities in enterprises in relation to GDP (%)	2,39	2,43	1,67
	Searching for new competitive advantages based on the technological advancement of products, quality and innovation of the offered products, as well as mechanisms of internationalization of enterprises	8.1.c Global Competitiveness Index (GCI) - position in the ranking (position in the ranking)	39	41	-
	Entrepreneurship development (legal facilitations in running a business and access to financing instruments)	8.2.a Ease of Doing Business Index (ranking position) (ranking position)	-	25	-
Goal 9. Industry, Innovation and Infrastructure	Improving the legal and institutional environment conducive to undertaking risky innovative activities	9.1.a Global Innovation Index (ranking position)	-	46	38
	Development of industries and knowledge-intensive services	9.2.a Gross domestic expenditure on R&D in relation to GDP (%)	0,72	1,00	1,39
	Development of industries and knowledge-intensive services	9.2.b Expenditure of the enterprise sector on R&D in relation to GDP (%)	0,19	0,47	0,88
	Development of industries and knowledge-intensive services	9.2.c Share of net revenues from sales of new or improved products in total net revenues from sales in industrial enterprises (%)	11,3	9,5	10,0
	Development of industries and knowledge-intensive services	9.2.d Share of high-tech exports in total exports (%)	6,0	8,5	9,0
	Internationalization of enterprises, especially SMEs, by creating support instruments for Polish exporters and investors	9.4.a Share of export sales revenues in SME net revenues from the sale of products, goods and materials (%)	11,3	14,0	16,0
Goal 11. Sustainable cities and communities	Strengthening the capacity of cities and urban areas for sustainable development and job creation, as well as improving the quality of life of residents	11.1.d Share of alternative fuel buses in the total number of buses serving urban transport (%)	2,3	3,6	12,2
	Strengthening the capacity of cities and urban areas for sustainable development and job creation, as well as improving the quality of life of residents	11.1.f Percentage of municipal waste intended for specific treatment in relation to the amount of waste generated (recycling, %)	14,82	26,39	26,68
	Strengthening the capacity of cities and urban areas for sustainable development and job creation, as well as improving the quality of life of residents	11.1.f Percentage of municipal waste intended for specific treatment in relation to the amount of waste generated (composting or digestion, %)	1,50	6,09	12,03
	Strengthening the capacity of cities and urban areas for sustainable development and job creation, as well as improving the quality of life of residents	11.1.f Percentage of municipal waste intended for specific treatment in relation to the amount of waste generated (thermal transformation, %)	0,32	13,25	21,52
	Strengthening the capacity of cities and urban areas for sustainable development and job creation, as well as improving the quality of life of residents	11.1.f Percentage of municipal waste intended for specific treatment in relation to the amount of waste generated (landfilling, %)	66,80	54,29	39,78

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Goal 12. Responsible consumption and production	Increasing the efficiency of resource use and changing the approach to resources by departing from their linear management, as well as changing consumption patterns (development of a circular economy)	12.1.a Resource productivity (euro / kg)	0,58	0,70	0,82
	Increasing the efficiency of resource use and changing the approach to resources by departing from their linear management, as well as changing consumption patterns (development of a circular economy)	12.1.b Domestic Material Consumption (DMC) per capita (tons)	16,32	16,28	17,01
	Increasing the efficiency of resource use and changing the approach to resources by departing from their linear management, as well as changing consumption patterns (development of a circular economy)	12.1.c Material recycling rate (%)	10,8	11,6	9,9
	Development of organic farming	12.2.a Share of certified organic agricultural area on organic farms in the total agricultural area in agricultural holdings (%)	2,07	3,45	2,68
Goal 13. Climate action	Effective reduction of CO2 concentration in the atmosphere	13.1.a Dynamics of CO2 emissions (2010 = 100) (%)	100,0	93,6	90,6
	Introduction of innovative technologies for the use of available energy sources, including the development of geothermal energy	13.2.a Share of energy from renewable sources in gross final energy consumption (%)	9,28	11,88	16,10
Goal 15. Life on land	Protection and improvement of the quality of the environment through the protection of biodiversity, including area forms of nature protection, waste management system, improvement of quality and protection of water purity	15.1.b Share of devastated and degraded land requiring reclamation in the total area (%)	0,196	0,203	0,200
	Modernization and expansion of sewage treatment plants and sewage systems, as well as air protection (elimination of pollution emission sources or reduction of their impact) and soil protection	15.2.b Percentage of population using sewage treatment plants (total, %)	64,7	72,7	74,8
	Modernization and expansion of sewage treatment plants and sewage systems, as well as air protection (elimination of pollution emission sources or reduction of their impact) and soil protection	15.2.b Percentage of population using sewage treatment plants (in the city, %)	88,0	94,6	94,7
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	Modernization and expansion of sewage treatment plants and sewage systems, as well as air protection (elimination of pollution emission sources or reduction of their impact) and soil protection	15.2.c Industrial and municipal wastewater treated biologically, chemically and with increased removal of biogens in% of wastewater requiring treatment (%)	65,73	70,90	73,32
Goal 16. Peace, justice and strong institutions	Improving the quality of legislation and its application	16.2.a Law quality indicator (points)	0,98	1,00	0,89
Goal 17. Partnerships for the goals	The geographical priorities of Polish development aid cover the countries of the Eastern Partnership, Asia, Africa and the Middle East	17.1.a Total Official Development Assistance (USD million, current prices)	377,75	440,89	829,27
	The geographical priorities of Polish development aid cover the countries of the Eastern Partnership, Asia, Africa and the Middle East	17.1.b Total bilateral official development assistance (USD million, current prices)	96,04	100,19	225,08
	Six main thematic areas of aid have been selected for the 2016-2020 period: good governance, democracy and human rights, human capital, entrepreneurship and the private sector, sustainable agriculture and rural development, environmental protection	17.2.a Official Development Assistance in relation to gross national income (%)	0,08	0,10	0,14

Source: own compilation based on BDL, Word Bank

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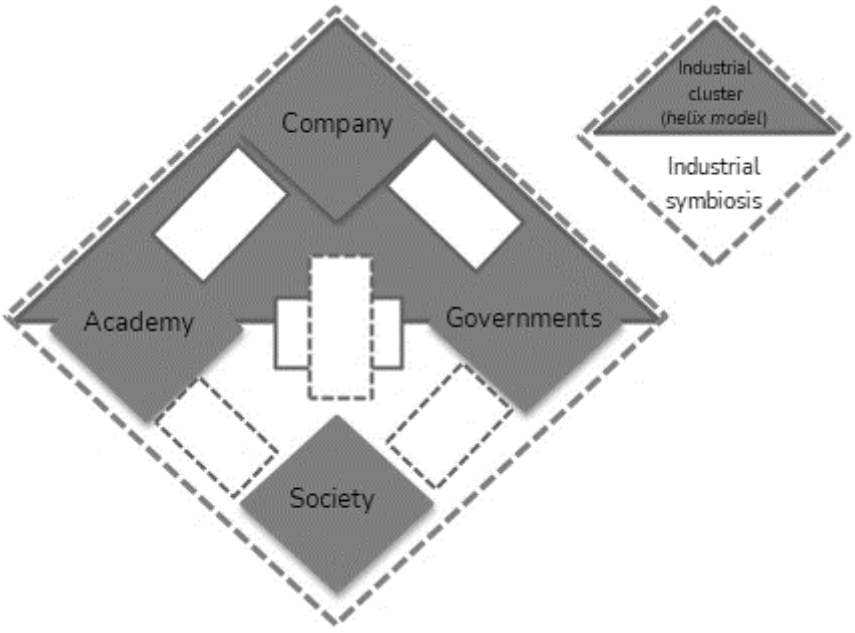
3.2. Circular Regional Clusters

There are a number of approaches to defining the Circular Economy in the scientific literature. The most common is the definition of the Ellen MacArthur Foundation, which states that: A circular economy is an industrial system that is planned and designed to restore and regenerate. It replaces the concept of "end of life", is geared towards the use of renewable energy, eliminates the use of toxic chemicals that impede reuse, and aims to eliminate waste by better designing materials, systems, and products within business models. Firstly, this definition draws attention that a circular economy is a broad approach that takes into account (apart from products), processes, organizational methods (including business) and marketing methods. Secondly, it is desirable to see in this approach a systemic (holistic) approach, also of the nature of industrial symbiosis.

It is worth indicating that, Poland currently is dealing with a transition period of introducing a circular economy - a period of "learning the situation". That is why, there are various market inconveniences and, additionally, the need to develop a strategy to adapt to current trends. Solutions and models are sought to make the implementation of a circular economy more effective, or at least neutral in terms of costs and quality. It will take the form of a rooted habit at the level of various interest groups. The main actors are crystallizing – the stakeholders of the change (process entities), who play a key role in the implementation of the circular economy assumptions. They include four basic groups: company, governments, academy and society (Fig. 5).

Figure 5. Stakeholders in Circular Regional Clusters



Source: own compilation

It should be noted that the process of transition to CE is not in the planning stage but is already in progress. Both public administration, scientific institutions and entrepreneurs have been implementing individual elements of a circular economy for many years. Measures

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implemented so far under the banner of green economy, cleaner production, sustainable development or low emissions often contribute to "closing the loop." Their primary goal is often to produce and use goods as efficiently as possible and manage waste economically and environmentally. A key actor of change and also the missing link is the local community. The issue is not only about passive awareness. The local community is obliged to actively engage in circular systems: by changing and adjusting its norms of behavior, assuming the role of producers (prosumers), consciously shaping market preferences and market demand, independently providing each other services. The circular economy is strictly territorial. This means that the properties of the territory - the properties of each of the key stakeholder groups are crucial for building the competitiveness of CRC. Relations between stakeholders are also crucial (see more: *10. Territorial compass for institutional cooperation in CRC*). On the one hand, it is about shaping a new form of the market where products do not appropriate the value of resources (see more: *5. Market failures in Circular Territorial Clusters*). On the other hand, the goal of stakeholder cooperation and involvement in the creation of a circular market is to take advantage of opportunities in goods that have not yet been perceived as resources. The goal is also to discover and use by-regional potential. Until recently, this group has been completely ignored in network analyses of industrial cluster organizations. **A special role of initiation, showing good practices and coordinating the unorganized circular market was assigned to local and regional governments.**

However, the transformation of the economy from a traditional market model to a circular economy requires profound changes not only in structures but also in the awareness of its participants. The existence of a circular economy requires building new business models (Lewandowski, 2016). It is therefore ineffective to use existing methods and tools in traditional ways to support market processes. This also applies to the organization and operation of economic networks, especially industrial clusters (innovation clusters according to Ph. Aydalot, 1986). The organization of an industrial cluster aimed at building a circular value chain does not bring positive results in the transformation of the economy towards its circularity. An industrial cluster based on the helix model is determined by sector (in its various versions, Etzkowitz, Leydesdorff, 2000). The sectoral similarity of participants and proximity of related sectors is a basic property of clusters described by Marshall (1920), Aydallot (1986), Poter (1998), Camagni (2008) and others. In other words, the basis for the competitiveness of industrial clusters is the formation of an added value chain, based on partnerships according to the helix model, around a dominant raw material or product. In a network organization with such a monothematic object of operation, it is difficult to achieve closure of the circulation of products and raw materials while eliminating waste. It should be remembered that the basic feature of industrial clusters is that entrepreneurs simultaneously compete and cooperate. We are dealing with the phenomenon of coopetition, which is also a strong determinant of territorial development processes (Przygodzki, 2018).

On the other hand, in the economic space, one can observe well-functioning socio-economic networks based on the logic of natural ecosystems, the so-called entrepreneurial ecosystems (Dońca, 2011). Relationships of economic actors and public and social institutions in such networks have the character of symbiosis. Symbiosis means, as in nature, relationships in which two or more unrelated species exchange materials, energy or information in a mutually beneficial way. On economic grounds, it is called industrial symbiosis. Industrial symbiosis involves cooperation and exchange relationships between different entities, including entrepreneurs, seeking synergistic effects. This type of cooperation most often also contributes

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to the development of social relations between participants. Industrial symbiosis also supports achieving the aims of sustainable development (Neves, et al., 2020, Kazancoglu, et al., 2021). This is because the objects of cooperation and interest of traditionally separate industries and services are resources and raw materials that are common to all: energy, water, and waste. Although the subjects of industrial symbiosis are most often partners representing different business sectors, they are able to recognize common areas of business interest. Industrial symbiosis can therefore be used naturally to promote a circular economy by creating more resource-efficient production systems (Martin, and Harris, 2018; European Commission, 2015; Lazarevic and Valve, 2017).

Many commonalities can also be seen between industrial clusters and industrial symbiosis. The primary reasons for industrial symbiosis and clusters are financial (business) benefits, long-term resource security (in the case of symbiosis, increased availability of critical resources, i.e. water, and energy), pressure from regulators and permits that require increased resource efficiency, emission reductions or elimination of waste. The key to industrial symbiosis, as in industrial clusters, is the geographic proximity of partners (Chertow, 2000; Qinghua, et al., 2007). It is also worth noting that self-organization is already one of the basic stages in the formation of industrial symbiosis (Shi, Chertow, 2017; Turken, Geda, 2020; Bijon et al., 2022). Self-organization is at the same time an important new direction in the evolution of market and non-market services in the context of the sharing economy (Chądzynski, Trippner-Hrabi, 2021; Chertow, 2007) Industrial symbiosis can be shaped in both a regional and territorial scale, as well as can take on an individuated form involving a narrow group of economic entities (Mulrow et al., 2017).

To sum up, it is, therefore, necessary to ask whether it is possible to combine the features of an industrial cluster (its market dynamics and engine) with economic symbiosis (determined by social responsibility and ecological sensitivity).

The answer is yes. A network of this type is the Circular Regional Cluster (CRC). However, such an organization is not a simple sum of industrial symbiosis and industrial cluster. It also contains characteristics specific only to itself. The CRC is not an ordinary industrial cluster because it is not based on companies from the same sector or related sectors. This is a fundamental difference. The CRC is not just industrial symbiosis because the primary objective of operating in an economic network is not limited to SDGs and managing the closed cycle of natural resources. So, what are the most important features of the CRC?

A Circular Regional Cluster is a kind of locally embedded economic network. Embedding in this case has a strong link to the existence of short supply chains for raw materials and goods. In this network, besides the classical actors for Helix models (Triple, Quadruple, Quintuple Helix), citizens (Society) play an important economic role. Here, society is seen as a co-producer, who is an active, economic market participant. The CRC is a multi-sector network due to the thematic scope of the Circular Economy [CE]. An important area of CRC interest is waste, which is perceived as multi-component raw material. Therefore, their use in particular involves partners from various economic sectors. CRC is built on added value chains created between companies of various industries. This type of relationship is based on both individual and collective benefits. The functioning of this type of cluster requires an appropriate environment – an entrepreneurial social ecosystem. It is a combination of the properties of Innovation Milieu (industrial cluster) with the features of ecological systems, by including inhabitants as producers of goods and raw materials (Fig. 6).

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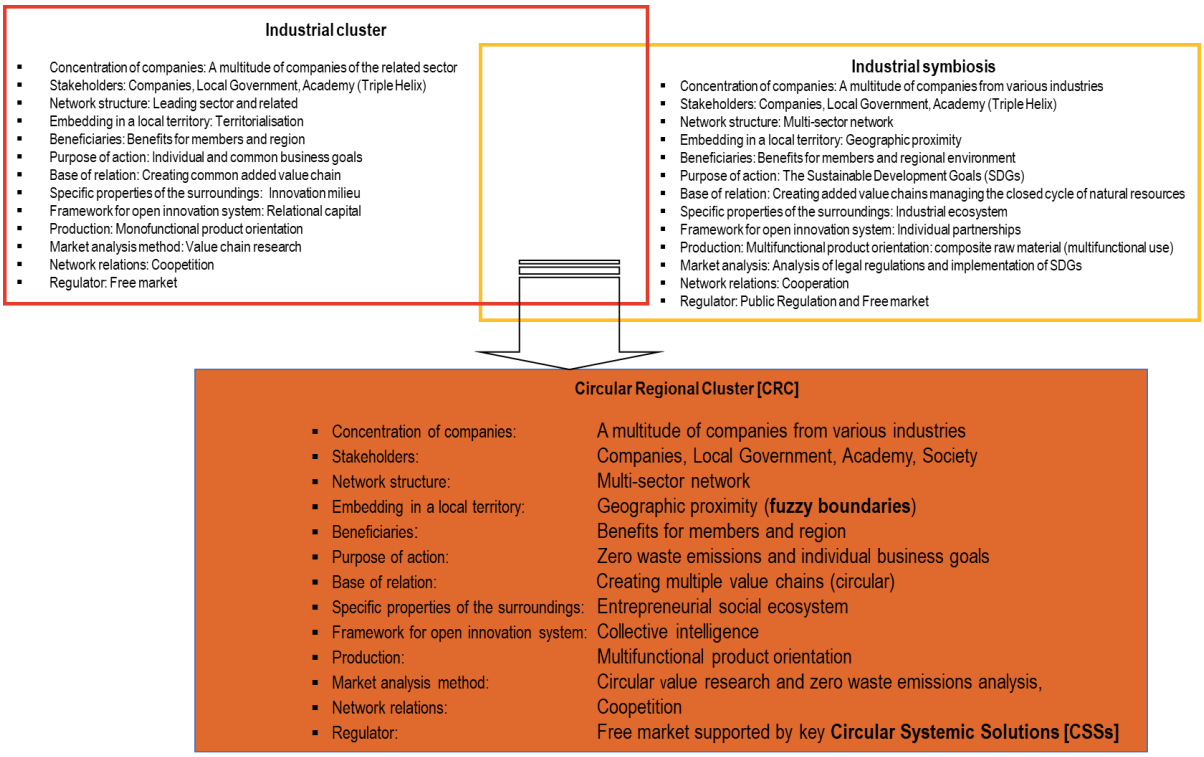
Figure. 6: Definition of Circular Regional Cluster in the context of Industrial Cluster Theory and Industrial Symbiosis Theory



Source: own compilation

The CRC uses an open innovation model schema. The processes of knowledge diffusion and mutual learning are in the nature of collective intelligence choices. So collective decision-making capacity is more important than a potentially better individual solution in a particular community. This method of optimizing choices results from limitations in the perception of the CE market, concerning, first of all, legal and formal barriers and market failure and secondly, the lack of incentives or differentiated effectiveness of incentive communication models. CRC is a business organization because profit is the strongest motivation for partner involvement including society. Hence, relationships besides cooperation between CE market participants also have a competitive dimension. The business model for organizing the local CE market in the CRC formula can take many forms, but it's important feature is the dominant market nature of regulations, enhanced by Circular Systemic Solutions [CSSs].

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3.3. System Engines - Circular Systemic Solutions

Circular Systemic Solution (CSS) - socially, economically and ecologically integrated demonstration project for deploying and strengthening the circular economy process in the Circular Regional Cluster [CRC]. CSS as innovation should have high replicability and scalability potential in other territories. CSS has an impact on an urban or regional scale. For territorial regeneration CSS should base on a multi-stakeholder and involve key social, economic, academic and public local partners, putting citizens' needs at the centre of development. Typically, CSS is applicable a ponse to the current pandemic crisis and environmental urgencies in the Lodzkie Region. This will be achieved through the deployment of four highly replicable, modular and scalable Circular Systemic Solutions for territorial regeneration based on a multi-stakeholder approach putting citizens' needs at the nd addressed to more than one economic sector, key product value chain, and technological processes targeted by the new EU CEAP that are linked with the decarbonisation of Europe. The sustainability challenge posed by key value chains requires urgent, comprehensive and coordinated actions, which will form an integral part of the sustainable product policy framework (A new Circular Economy Action Plan EC 2020). The role of CSS is the fundamental rebuilding of the system by changing the structure of its key feedback loops. The aim of CSS is to support an effective, safe and sustainable symbiosis within and between economic sectors. In particular, increase their circularity, involve circular participative social and governance models, and demonstrate sustainable products, and services business models. CSS should help to create critical mass and facilitate public and private investments, including criteria of industrial ecology and ecodesign, increase the integration between production, services and consumers, and facilitate technology deployment, with special attention to more efficient and sustainable technologies. (Przygodzki, 2022).

Support for systemic solutions may concern various areas of economic activity struggling with the problems of creating a circular economy. FrontSH1P vision is to demonstrate how innovative models of circular (bio)economy can act as a catalyst for socio-economic growth also in res centre of development. This systemic approach addresses four key strategic sectors, namely: Wood Packaging, Food and Feed, Water and Nutrients as well as Plastics and Rubber. Specific objectives for each CSS include (101037031 FrontSH1P – Part B, p. 10). (Tab. 2)

Table 2. Specificity of selected systematic solutions

CSS1 wood	1) Creation of a new value chain based on wood packaging waste valorisation, involving the whole community and implementing the circular economy approach (refurbishing, reusing, recycling, energy recovery); 2) Coupling of biomass gasification for renewable heat generation and postcombustion capture of CO2 towards carbon negative emissions with up to 80% efficiency of post-combustion capture and decrease in NOx emission by > 20% obtained by CH4/syngas cofiring; 3) Exploitation of char as pigment/filler in the plastic industry or as an additive for compost; 4) Exploitation of CO2 in CSS4 for biomaterials production.

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1) To develop a CO2 assisted pre-treatment of agro-industrial waste combined with biotechnological treatments for the obtaining of sugars and FFAs as component for foaming biomaterials;

2) To establish innovative genotypes of oil crops (rapeseed, milk thistle) in marginal lands to obtain biodegradable biolubricants formulations, bio-oils for insulating materials and locally available animal feed;

3) To produce biobased building blocks (diols and dicarboxylic acids) from second generation feedstock (from regional agro-industrial waste) for the formulation of new compostable bioplastics for bags for separate OFMSW collection.

1) To further develop to higher TRL a compact waste water management unit for nutrients (P, N, K) extraction from agricultural waste-waters and a bigger plant for municipal wastewater both using microalgae;

2) To produce circular bio-stimulants from wastewaters;

3) To close the water loop and recycle clean water.

1) To optimize a high TRL pyrolysis system for chlorinated compounds;

2) To further develop a high TRL supercritical CO2 expansion system for insulating biomaterials;

3) To demonstrate low-cost 3D printing for repairing of household appliances.

Source: own compilation based on 101037031 FrontSH1P – Part B, p. 10

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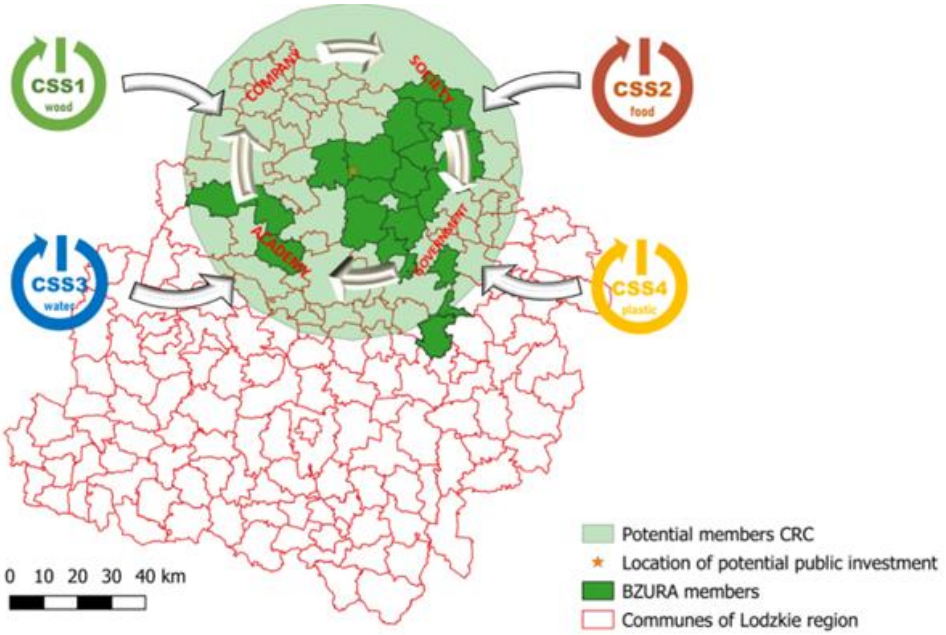
3.4. The territory of the Circular Regional Clusters

Circular Regional Clusters are a type of cluster-like business network. This network is territorial and is closely linked to local conditions of an economic, social and environmental character. As in industrial clusters, the key cluster partners (the cluster core) are characterized by geographical proximity. The results of cluster surveys suggest that the partners of the cluster core are usually located no more than an hour's commuting time between them (Solvell, et al., 2003). Of course, the organization is also open to other partnerships from the region and from beyond the region and the country. Nevertheless, the dynamics of the network are based on partners from the cluster core. In the case of the research carried out in the Frontsh1p project, the core of the cluster is the 19 municipalities that have established an association (the Bzura Intermunicipal Union). The demographic potential of the IU Bzura municipalities is 146,505 residents (CSO 2020).

Figure. 7. Frontsh1p runner organization model: Circular Regional Cluster (CRC)



Source: own compilation

The association aims to reduce the amount of pollution in the environment, introduce rational waste management by increasing the degree of segregation, recovery and recycling of waste, improve environmental management and the living conditions of residents and increase the importance of the environment as a driver of socio-economic development, as well as create new jobs related to the circular economy. The central location of the union's municipal investments is the investment area in the village of Piaski Bankowe in the municipality of Bielawy. The area is centrally located in the northern part of the Lodzkie Region. In addition to the municipalities that are members of IU Bzura, there are an additional 60 other municipalities in close proximity (Fig. 7). These municipalities can be considered potential members of the developing CRC. The broker of the cluster in its initial stage of organization is the Board of the IU Bzura. It is therefore a public government.

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4. Legal and formal barriers for functioning CRC

4.1. Methodology

4.1.1. State of the art

The purpose of the study is to disclose the legal barriers to the implementation of a circular economy in Poland in particular in Lodzkie Region. Legal and formal barriers can be a starting point to create the framework to change, optimize and promote sustainable production and consumption through new models based on unrestricted growth.

The research goes like Govindan and Hasanagic (2018) study, which identified five categories of entities : employees, clients, shareholders, governments, and non-governmental organizations (NGOs). To achieve this, above mentioned actors, require to organize tactics and governmental enforcement of regulatory frameworks to minimize the number of barriers and create the determinants for this challenging transition (Agyemang et al., 2019).

The challenge of this process appears primarily because CE is still a vague term with many applications, including closed supply chains, product-service systems, and sustainable production and consumption systems, what is needed for the Circular Regional Cluster (CRC). Seeing CE as the opportunity to combine environmental and economic issues into one entrepreneurial ecosystem there is a great opportunity for policy and decision makers to introduce a new legal framework.

The literature points out that policy and regulatory barriers are one out of seven categories, which could be overcome to promote, regulate and monitor further development (Agyemang et al., 2019; Araujo Galvão et al., 2018; Charef et al., 2021; de Jesus, Mendonça, 2018; Govindan, Hasanagic, 2018; Hina et al., 2022; Mahpour, 2018; Mangla et al., 2018; Oluleye et al., 2022; Ranta et al., 2018; Upadhyay et al., 2021).

The Chatham House research specifically noted the following obstacles to CE implementation (Preston, 2012): lock-in to resource-intensive infrastructure and development models, political obstacles to putting an appropriate price on resource use, complex international supply chains, challenges for company-to-company cooperation. The encouragement of innovation, the creation of favourable circumstances for investment, and the standardization of goods are just a few of the important roles that governments must play (Jakhar et al., 2019).

Barriers are also classified by impact category according to the following sheme (Cramer, 2017, 2020):

- Regulatory constraints **[R]**
- Impact on the economic process **[E]**
- Customers' attitudes [**C]**
- Organizational obstacles [**O]**
- Institutional aspects **[I]**

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The barrier were determined, how they affected the circular economy model's transformation. On a scale of 1 to 5 determined by the authors, the effect of each obstacle was indicated.

Depending on the nation and the economy, a different combination of policies aimed at establishing connections between entities of CRC will be appropriate. The amount of market liberalization and the creation of favourable conditions may be seen in the recycling industry, where, for instance, a United Kingdom assessment found that waste collection and recycling are less economically advantageous choices for SMEs that create tiny volumes of garbage. (Rizos et al., 2015). The size of the organization plays a significant role, as the legislative lack of regulations influence the SMEs in a more significant way than large companies as the European directives as EMAS (the European Eco-Management and Audit Scheme) (Calogirou, C. et al., 2010; OECD, 2010). Management is reluctant to use new technology for sustainable operations due to insufficient laws and oversight over small and medium-sized businesses and auxiliary organizations (Kumar, Singh, and Kumar, 2021).

Reduced raw material use is one of the trends in contemporary law. However, the regulations' shortcomings are evident from the inadequate implementation of them and other issues related to the CE. Particularly, the growth of the circular economy is not supported by the present waste management laws (Li and Yu, 2011; Govindan and Hasanagic, 2018). Legislative barriers can be identified in three areas (Takacs, Brunner, and Frankenberger, 2022):

- hindering legislation,
- lack of institutionalized system and standardization,
- lack of clear vision from legislators on CE in public procurement

Growing concerns about global warming, the phase-out of gasoline and diesel vehicles and transportation, and the scarcity of resources at landfills may prompt changes in many sector laws that might catalyse the transition to a circular economy (Upadhyay et al., 2021). The sectors like packaging, plastics, wastewater, agriculture, energy are covered by plenty of laws, ordinances, restrictions, and uncertainties. This leads to a disjointed and complicated legal system at the European, national, and municipal levels (Hina et al., 2022; Khajuria et al., 2022). It is worth mentioning the legal guidelines which aim for a linear model, where a product is treated as waste in its ultimate stages, most often after being recycled or "down-cycled" into goods have less of an impact on the environment. (Jaeger and Upadhyay, 2020). In this regard the company has not yet achieved all it can with implementing circular economy. The subject of people's involvement in the CE approach is also raised and should be imposed by law (Charef, Ganjian, and Emmitt, 2021). Governmental policies, laws, and regulations have a significant impact as it transitions from linear to CE as corporate environmental management, the participation of the government is crucial to advance CE procedures, (Kazancoglu et al., 2021).). However, limitations that have been identified, such as a lack or ineffectively implemented of environmental rules and regulations, a lack of environmental management certifications and systems, and a lack of favourable tax policies to support circular models are at least influencing the transformation (Mangla et al., 2018; Ranta et al., 2018).

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4.1.2. Methods of research

The complexity of legal and formal barriers has determined the research methodology, which is based on the use of triangulation of research methods. In addition, the topic of barriers to the implementation of Circular Economy was developed in the chapter on identifying Market Failure and Green Public Procurement. The following research methods were selected:

1. Participating observation with moderation of the discussion during two seminars with the participation of experts related to waste management in local government units. The experts were representatives of the communes included in the Inter-Communal Association of Bzura (MZ Bzura). During the seminar, the basic areas of formal failures were identified.
2. Questionnaire addressed to selected local government units. The questionnaire was addressed to the communes that are part of the Inter-Communal Association of Bzura. The general population comprised 19 communes, 9 of which took part in the study. In order to increase the representativeness of the results, an additional 60 communes from the Lodzkie Region from the CRC area were selected. Another 6 municipalities replied. A total of 15 responses were obtained. The study was conducted in the period from 01/03/2022 to 03/03/2022. The questionnaire was carried out online. The questionnaire was addressed to members of the Inter-Communal Association of Bzura. The aim of the questionnaire was to find out:
   - How municipalities deal with the implementation of the circular economy concept in their areas,
   - Whether municipalities establish cooperation in this area based on the existence of the created inter-communal relationship,
   - What is the degree of advancement of individual municipalities in implementing the concept of the circular economy.
3. Study visits: 1. Study visit in a municipal company dealing with municipal waste management - Study visit in Orli Staw. The company associates 23 municipalities from the neighboring region and is considered a leader in the industry in Poland. 2. A study visit was carried out in a twin enterprise, focused on the implementation of innovative solutions in the field of waste management in the Malopolska Region – Study visit in The ECO-INCINERATOR (Communal company allows to process 220 thousand tons of municipal waste during the year. Approximately 65,000 MWh of electricity and 280,000 MWh of heat are produced as a result of the combustion. The energy obtained by way of the thermal transformation process is largely organic and renewable).
4. Unstructured interview with local government officials of the Inter-Communal Association of Bzura, employees of the Inter-Communal Association of Bzura, and municipal officials of the Inter-Communal Association of Bzura responsible for the performance of duties related to the municipal waste management system. The respondents were experts who in practice handle matters related to waste management. 3 interviews were conducted.

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5. The desk research: analysis of legal acts, in particular the Waste Act, municipal cleaning regulations, New Action Plan for circular economy in the EU, literature on the subject, selected items (Cramer, 2020; Kulczycka, 2021), reports on projects implemented in this case (Replace, SCREEN, LCA4regions),

4.2. Results

During the observations of the participants, it was found that legal and formal barriers may be factual or apparent ones. In the first case, it concerns the occurrence of formal errors, contradictions in the law, loopholes in the law, imperfect definitions, inoperability of legal provisions, or difficulties in applying the law. In the second case, failures result primarily from the lack of awareness and knowledge about the legal institutions of the stakeholders, the inability or the ability to interpret the law, and the existence of erroneous, outdated behavior patterns.

The analysis of the survey questions made it possible to find out how municipalities deal with the implementation of the circular economy concept in their areas. What legal barriers and those related to various regulations prevent or significantly inhibit the possibility of introducing this concept.

Desk research, in-depth interviews as part of Study Visit and information from survey research allowed us to prepare applications in the form of a table (Tab. 3). The table gives an analysis of local-level documents as well as national and European law in Poland. The information provided below outlines factors and roadblocks that obstruct or inhibit the dynamic development of new business models. Four levels of analysis: local, national, regional, European have been adopted, providing a multilevel understanding of the legal environment in which players operate. The conclusion that is being given provides evidence and a picture of the legal setting that promotes CE solutions and the fundaments for economic symbioses. Companies and stakeholders engage in activities in such an institutional ecosystem intending to lower the consumption of basic raw materials and recycling by-products. By-products made from waste produced during the production process might boost the production process sustainability. The study that is being provided contains seven obstacles and a ranking of each barrier's relevance for the functioning of non-linear business models, which is determined by how much the legal framework affects the system. The degree of influence on particular stakeholders is shown in the regulations that are mentioned.

Table. 3. Systematic approach to the legal barriers across european and polish legal system

	Barrier's title	Impact assessment*	Intensity assessment**	Legal act	
				Art of regulation***	regulation
1	1. A system of fees[1] paid by citizens and property owners serves as the **primary financing source** for municipal waste	R, E	5	N	Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes: art. 6h- 6r (subject of the fee, method of calculation, method of imposition, method of declaration)

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	management system within the local government unit; 2. Inadequate level of fees for municipal and industrial waste collection. **Recommendation -** changing the system of setting fees for collecting waste to clarify their rates and introducing an additional source of financing the waste management system in the form of introducing a system of fees paid by entrepreneurs for extended liability of the entrepreneur.			L	Resolution of the commune council (the fee for the collection of communal waste is imposed by a resolution of the commune council and constitutes the income of the commune budget) From the fees collected for municipal waste management, the commune covers the costs of operating the municipal waste management system, which include the costs of: 1) collection, transport, collection, recovery and disposal of municipal waste; 2) creation and maintenance of separate municipal waste collection points; 3) administrative support of this system; 4) environmental education in the field of proper handling of municipal waste.
				E	Communication form the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A new Circular Economy Action Plan For a cleaner and more competitive Europe (Brussels, 11.3.2020, COM(2020) 98 final): The Commission will present waste reduction targets for individual streams as part of a wider set of waste prevention measures in the context of Directive 2008/98 / EC. The Commission will also improve the implementation of the recently adopted requirements for extended producer responsibility schemes, provide incentives and encourage the exchange of information and good practice on waste recycling. All this is aimed at achieving the goal of significantly reducing the total amount of waste generated and halving the amount of residual (non-recycled) municipal waste by 2030. https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:32004L0035&from=PL this act sets out the Polluter Pays Principle and environmental responsibility http://publications.europa.eu/resource/cellar/113a2c92-81f9-4d72-8a83-a58a071e8a05.0012.03/DOC_1 They present their plans towards the tightening of the producer responsibility policy in the chapter of the Action Plan: 6.2. Ensuring adequate cost effectiveness In addition to activities from the GOZ platform
2	- Lack of adequacy and precision of the system of qualifying and reclassification waste to a specific raw material group;	R, E	4	N	Journal Of Laws of 2013, item 21 Act of 14 December 2012 about waste: A. Art. 3 par. 1 pnt. 7 (the definition, in particular, of the B. term municipal waste) C. D) Chapter 3 (Waste catalog and change of hazardous waste status to other waste

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	- Lack of proper definition of the concept of waste at the statutory level; - Executive regulations are not issued quickly enough to let waste to be classed as a raw material needed as a substrate in the manufacturing process (side product qualification); - The possibility of any classification of waste by the commune in order to avoid the statutory penalty in the event of failure to achieve the statutory recycling levels **Recommendation:** The proper definition of the concept of waste at the statutory level; clarification of the waste classification system. Faster issuance of executive regulations to acts enabling reclassification of waste into raw material for the entrepreneur's needs.				than dangerous); Chapter 4 (Identifying an object or substance as a side product); D. Chapter 5 (End of waste status) The minister responsible for climate affairs in agreement respectively with the minister competent for: construction, planning and development spatial and housing, energy, economy, maritime economy, communication, computerization, agriculture, transport, inland navigation, internal, health and the Minister of National Defense, may determine, by regulation, separately for one or several cases, for some wastes, specific conditions loss of waste status.
				R	Art.. 8 par. 5 (B) and D)): The voivodship marshal issues a decision approving the reclassification hazardous waste to non-hazardous waste or a decision to express objection.
				E	Communication form the Commission to the european Parliament, the Council, the European Economic and Social Committee and the Committee of the Regoions: A new Circular Economy Action Plan For a cleaner and more competitive Europe (Brussels, 11.3.2020, COM(2020) 98 final): To help citizens, businesses and public authorities better segregate waste, the Commission will propose to harmonize separate collection systems. In particular, this proposal will address the most effective combinations of different collection models, distribution density and availability of collection points, also in public spaces, taking into account regional and local circumstances, ranging from urban to outermost regions. Other aspects to facilitate consumer involvement, such as common colors for containers, harmonized symbols for the most important types of waste, product labeling, information campaigns and economic instruments will also be considered. The Commission also envisages pursuing the standardization and application of quality management systems to ensure high-quality waste collected for use in products, in particular as food contact materials. http://publications.europa.eu/resource/cellar/bb120f99-8ff5-11e4-b8a5-01aa75ed71a1.0017.03/DOC_1 in which the codes for all waste are specified, along with instructions for handling instructions
3	Construction of the Database on products (BDO), packaging, and waste management resulting in the lack of availability of information on the amount of waste available in the municipality, and its marketization including anonymization at the appropriate level;	R, I, E	3	N	Journal Of Laws of 2013, item 21 Act of 14 December 2012 about waste: art. 79-84a (Database on products, packaging and waste management (BDO)) Database on products, packaging and waste management (BDO) collects in particular information about: 1) packages and products introduced on the territory of the country in packaging, broken down into individual types of packaging, and waste generated from them;

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	Recommendations: A. Improvement of data availability at the voivodeship level; B. Broadening the personal scope of accessibility; C. Ensuring an appropriate level of data anonymization.				2) lubricating oils and tires introduced into the territory of the country and the waste generated from them; 3) introduced vehicles, waste electrical and electronic equipment, batteries and accumulators and the waste arising from them; 4) Achieved levels: a) recycling of waste resulting from the packaging referred to in point 1, b) recovery and recycling of waste resulting from the products in question in point 2, c) recovery and recycling of vehicles, d) collection, recovery, preparation for re-use and recycling waste electrical and electronic equipment, e) collection, recycling and recycling efficiency of waste and spent batteries batteries; 5) types and quantities of waste generated and their producers; Only the appropriate authorities and authorities have access to the database. Economic entities and residents do not have access.
				R	The voivodship marshal, in particular: 1) keeps and updates BDO, including the register; 2) processes data and information collected in BDO
				E	CircLean is an initiative of the European Commission. It is implemented by a consortium led by Technopolis Group, including Trinomics, International Synergies LTD and Arctik. The core consortium is ably supported by leading network organisations A.SPIRE, ACR+ and EIR Raw Materials. CircLean is a network of businesses and SMEs for IS. The purpose is to set up a network of businesses to seize Industrial Symbiosis business opportunities. CircLean is suitable for industry actors; business associations; public authorities; and R&I stakeholders. CircLean is EU-wide, flexible, industry-led, sustainable, voluntary, and needs-centred.
4	Insufficient functionality of the verifications system of implementation of the 10R rules[1] by municipalities, as entities managing the waste management system. A. Far-reaching freedom in the reporting of obligations imposed on entrepreneurs collecting municipal waste from property owners;	R, I, O	4	N	Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes: Obligations of 1. Entities collecting municipal waste from property owners (art.9d, art. 9e, art. 9g art. 9h), 2. Entities operating a separate collection point for municipal waste (art. 9ea) in particular, A. to transfer selectively collected municipal waste directly or through another waste collector to waste recovery or neutralization installation, in accordance

[1] By systematically researching ways of advancing up the circularity ladder (see below), we can prevent waste and create potential value. We apply the following rules. Refuse: prevent raw materials use. Reduce: decrease raw materials use. Renew: redesign product in view of circularity. Re-use: use product again (second hand). Repair: maintain and repair product. Refurbish: revive product. Remanufacture: make new product from second hand. Re-purpose: re-use product but with other function. Recycle: salvage material streams with highest possible value. Recover: incinerate waste with energy recovery

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	B. Lack of sufficient instruments and financial means to control the fulfillment of the above-mentioned obligations by communes. **Recommendations:** A. Improve the functioning of the reporting system; B. Equipping municipalities with appropriate control measures.				with the hierarchy of methods for dealing with waste referred to referred to in Art. 17 of the Act of December 14, 2012 on waste and unsorted (mixed) municipal waste directly to the municipal installation (A,B) B. to transfer unsorted (mixed) municipal waste directly to the municipal installation (A) The entity collecting municipal waste from property owners and also the entity running a selective municipal waste collection point are obliged to draw up annual reports (art. 9n, art. 9na). The report contains, in particular, information on the weight: a) individual types of municipal waste collected from property owners and the manner of management donating the waste, indicating the name and address of the installations to which it was transferred, b) municipal waste sent for preparation for reuse and recycling. The entity collecting municipal waste on the basis of an agreement with the property owner is obliged to also include in the annual report information on the achieved level of preparation for re-use and recycling cling of municipal waste, the level of limitation of the mass of biodegradable municipal waste, important for storage and the level of storage. Journal Of Laws of 2013, item 21 Act of 14 December 2012 about waste: art. 66-72 (Records of waste); art. 73-78 (Reporting on products, packaging and waste management) The holder of waste is obliged to keep them on an ongoing basis quantitative and qualitative records in accordance with the waste catalog specified in the regulations (waste records), (art. 66)
				R	The head of the commune, mayor or city president is obliged to prepare an annual implementation report tasks in the field of municipal waste management. 2. The report is submitted to the voivodship marshal and the voivodship environmental protection inspector by March 31 of the year following the year to which it relates. (Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes, art. 9q) Journal Of Laws of 2013, item 21 Act of 14 December 2012 about waste: art. 66-72 (Records of waste); art. 73-78 (Reporting on products, packaging and waste management) Voivodship Marshal competent for the place of collection municipal waste, waste generation, waste treatment site or place residence or seat of the person transporting the waste that performs the transport service the waste, by way of a decision, obliges the holder of the waste to submit documents and any data where waste record documents raise doubts as to the correctness of preparation or when it is necessary to conduct others environmental protection procedures within its properties (art. 72 par. 3)
				11 L	The report is submitted to the commune head, mayor or city president by January 31 for the previous

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					calendar year. (Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes, art. 9n, art. 9na) In order to verify the data contained in the report, about which the commune head, mayor or city president may oblige, in particular, the entity collecting the waste municipal waste from property owners, entity running a point of separate collection of municipal waste, to present documentation mentation, on the basis of which documents are drawn up for the purposes of waste records and documents confirming processing waste. If the report is unreliable, the commune head, mayor or city president summons the entity, who submitted the report, to complete or correct it within 14 days. (Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes art. 9p)
				E	Communication form the Commission to the european Parliament, the Council, the European Economic and Social Committee and the Committee of the Regoions: A new Circular Economy Action Plan For a cleaner and more competitive Europe (Brussels, 11.3.2020, COM(2020) 98 final): Creating a well-functioning EU market for secondary raw materials: A number of actions foreseen, notably introducing requirements for recycled content in products, will contribute to preventing a mismatch between supply and demand of secondary raw materials and ensure the smooth expansion of the recycling sector in the EU. Furthermore, to establish a well-functioning internal market for secondary raw materials the Commission will: 1) assess the scope to develop further EU-wide end-of-waste criteria for certain waste streams based on monitoring Member States' application of the revised rules on end-of-waste status and by-products, and support cross-border initiatives for cooperation to harmonise national end-of-waste and by-product criteria; 2) enhance the role of standardisation based on the on-going assessment of existing standardisation work at national, European and international levels; 3) make timely use of the restrictions on the use of substances of very high concern in articles for cases where the use of the substance is subject to an authorisation requirement, while continuing to improve enforcement at borders; 4) assess the feasibility of establishing a market observatory for key secondary materials.
6	Application of public procurement rules to ensure that the municipality's waste collection business owners follow the competitiveness principle. **Recommendations:** Undertaking activities aimed at eliminating the monopoly of certain economic entities for the collection of municipal	R, I	3	N/L	Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes, art. 6d The head of the commune, mayor, or city president is obliged to award a public order for the collection of municipal waste from property owners or public order for collection and management of this waste. To organize the collection of municipal waste from property owners and to designate points for separate collection of municipal waste, the council of a commune with over 10,000 inhabitants may adopt a

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	waste. Greater marketization of services in this area. Creating facilities for starting a business in this area				resolution constituting an act of local law, on the division of the commune area into sectors, taking into account the number of inhabitants and density population in a given area and an area that can be served by one entrepreneur collecting municipal waste from property owners. If the commune is divided into sectors, the public procurement procedure for collecting wounding municipal waste from property owners is carried out separately for each of the designated sectors.
				E	Creating a well-functioning EU market for secondary raw materials
7	Low uptake of equipment repair and reuse points at selective waste collection points. **Recommendations:** introducing the legal obligation and not the possibility of municipalities to establish and maintain repair points and re-use of products or parts of non-waste products;	E, I, C	3	N/L	Journal of Laws - 4 - Item 1297 2022-06-24, Act of 13 September 1996 on maintaining cleanliness and order in communes, Art.. 3 par. 2 pnt. 6a Communes ensure cleanliness and order in their area and create conditions necessary for their maintenance, in particular, can create and maintain points for the repair and re-use of products or parts of non-waste products

*Category of barriers (Cramer, 2017, 2020): Regulatory constraints [R], Impact on the economic process [E], Customers' attitudes [C], Organizational obstacles [O], Institutional aspects [I].
**Intensity of assessment: rating scale from 1 to 5 points.
***Art of regulation: European [E], National [N], Local [L].

Source: own compilation

4.3. Conclusion

Both European literary works and legal documents are subject to the analysis performed for the study. The study's focus was on rules that suggested a need to alter the current legal system. The system has to be altered in order to become more circular, which prompts us to draw the following broad conclusions as well as more specific ones. The conducted research has shown that Polish local government units see their active role in the circular economy. This role is to consist, inter alia, of active participation in the functioning of the secondary raw materials market. This role is related to the fact that Polish local government units become the legal owner of municipal waste collected from citizens. The role of Polish local government units in the circular economy, according to the authors, requires confronting the role of local government units in other international partners of the Frontsh1p project. This will allow assessing to what extent and on what terms local government units of the project partners already participate or will participate in the future in the circular economy and, probably, how their role is perceived by individual countries participating in the project.

The confrontation of the role of local government units among individual project partners is especially important due to the importance that the European Commission attaches to eco-design. It seems that the development of eco-design, supported by the initiative of the Commission in the scope of relevant directives, may lead to the formation of many simple relations in the future between the owner of the waste (raw material), i.e. a citizen or entrepreneur, and another entrepreneur interested in its purchase.

The following detailed conclusions regarding the research carried out have been formulated:

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- A certain percentage of raw materials such as paper, metals, and plastics collected at separate collection points are not suitable for direct sale to a recycler;
- Vaguely defined municipalities' responsibilities for waste management and the organization responsible for waste management;
- Low diversification of the municipality revenue sources in the municipal and industrial waste management system;
- Circular economy regulations are scattered in many legal acts;
- A scarcity of recycling businesses, due to the authorities' inaction on pro-environmental initiatives;
- Processing secondary raw materials generated in Poland is less economical for recyclers than importing "raw material" from elsewhere,
- The environmental impact of products and services is not included in the sales price;
- Wrongly marked or lack of markings, certificates that the products come from raw materials;
- The expense of disposing of items whose life cycle is transitioning to the decreasing phase is transferred to local government units.
- The problem with the enforcement of penalties imposed for breaking the regulations by entities and residents operating on the market

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5. Market failures in Circular Territorial Clusters

5.1. Methodology

5.1.1. State of the art

The market is the basic mechanism that regulates relations between stakeholders within sectors as well as between sectors. Often, however, market mechanisms are distorted or intentionally turned off. We are then dealing with market failures. Market failures are an undesirable property of both classical linear and circular markets. The concept of market failure has its origin in modern welfare economics. As Ledyard indicated to understand market failure one should understand market success (1989, p. 185). Market success is explained in reference to Pareto optimal. It could be defined as the ability of idealized competitive markets to achieve an equilibrium allocation (Ledyard 1989.) Market success is described by the First Fundamental Theorem of welfare economics (Arrow, 1951; Debreu, 1959), i.e.:

(1) there are enough markets,

(2) all consumers and producers behave competitively,

(3) an equilibrium exists.

In such a case allocation of resources in equilibrium is Pareto optimal (Bator, 1958, Randal, 1983, Ledyard, 1989, Klaassen, Opschoor, 1991, Moreau, 2004). So, market failure arises when allocation in markets is not efficient and is not Pareto-optimal. In this way, market failure was defined by among others Bator (1958), Winston (2006), Conrad (2020), Klaassen, and Opschoor (1991). A similar definition was presented by Samuelson and Nordhaus (1992, p. 741), who also referred to inefficient allocation of resources but in the context of an imperfection in a price system. Pearce (1986, p. 13) described market failure as “The inability of a system of private markets to provide certain goods either at all or at the most desirable or ‘optimal’ level”. Lines et al. (2006, p. 167) indicated that market failure is represented by the forms of the growth of monopolistic firms and other non-competitive organizations and happens when factors of production stand idle. As Cunningham (2011, p. 13) implied the term “market failure” does not mean that a market is not working at all, but that it is not working efficiently because it is not producing desirable goods. The concept of market failure is often treated as a general justification for government intervention (i.e. Bleda and Del Río, 2013, Zerbe, McCurdy, 1999, Alvarez et al., 2015).

The most common categories of market failures are: public goods, externalities, imperfect competition, incompleteness of the market, and asymmetrical information (Randal, 1988, Stiglitz, 2004, Moreau, 2004, Jackson, Jabbie, 2019). Public goods occur when goods are non-rivalrous and non-excludable, prices might not reflect the costs and benefits to the organizations involved in the economic transaction, leading to non-optimal allocations of resources (Martinez Sanchez et.al, 2021, p. 12). Programs and training on the implementation

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of environmental knowledge and awareness, research and development related to CE for a clean environment have been recognized amongst the others as public goods. Externalities occur when one person's actions affect the welfare of another person, and the corresponding costs and benefits are not reflected in market prices. A positive externality occurs when, for example, residents benefit from cleaning up waste from a place that does not belong to them. Negative externalities occur when, for example, there is a chain of dependency. By not segregating waste, residents may not consider the costs that this neglect imposes on others. (Cowen 2008). Imperfect competition, incompleteness of the market, and asymmetrical information does not raise any interpretation doubts. Others add to this list also incomplete property rights (i.e., Perman et al., 2003, Acheson, 2006). Redmond (2018) presented market failure from a different point of view. He proposed a systems approach contrary to earlier, classic research, where market failure was analysed with a transactional approach. It let him distinguish one more category of market failure – transaction costs. This category of market failure appears in the New Institutional Economy (NIE), which looks at the organization of exchange from a market or hierarchical perspective. In NIE markets when market conditions threaten to increase transaction costs, hierarchies (i.e., firms) are created to minimize these costs. This can be perceived as a reaction to market conditions to maximize profits. However, from a neoclassical perspective, this constitutes market failure (Chang 2002).

A different approach was presented in the evolutionary economy, where the market is perceived as dynamic, chaotic, and constantly changing, rather than tending to a state of equilibrium (Nelson, Winter, 2002, Nelson, 2008, Schmidt, 2018). From this point of view, market failures typical for a neoclassic economy are not failures. As Bleda and del Rio (2013, p. 1049) indicated common problems in the evolutionary economy, such as uncertainty, limits in agents' knowledge, and difficulties in the coordination of knowledge and its carriers, are sources of coordinator failure. In evolutionary markets, failures are explained by the existence of undeveloped or ineffective mechanisms and constituent market.

In this paper, we looked at the market failure from the perspective of the circular economy. In a circular economy, it is more often to identify the barriers which derail or slow down the transition towards a CE (Kirchherr, 2017). The issue of barriers to implementing CE was raised by many authors (see Tab. 4).

Table 4. Categories of barriers to implementing CE occurred in the literature

Author(s)	**Category of barriers to implementing CE**								
	technological	market/ economic	political/ institutional	legal/ regulatory	social/ cultural	organizational	supply chain	infrastructural	lack of information/ knowledge
Agyemang et al., 2018	+	+	+		+		+	+	
Darla, Galvão, 2018	+	+	+	+					
de Jesus, Mendonça, 2018	+	+	+		+				
Geng, Doberstein, 2018	+		+		+				
Grafström, Aasma, 2021	+	+	+		+				
Kinnunen, Kaksonen, 2019	+	+		+			+		+
Kirchherr et al., 2018	+	+		+	+				
Mahpour, 2018	+		+	+	+		+		

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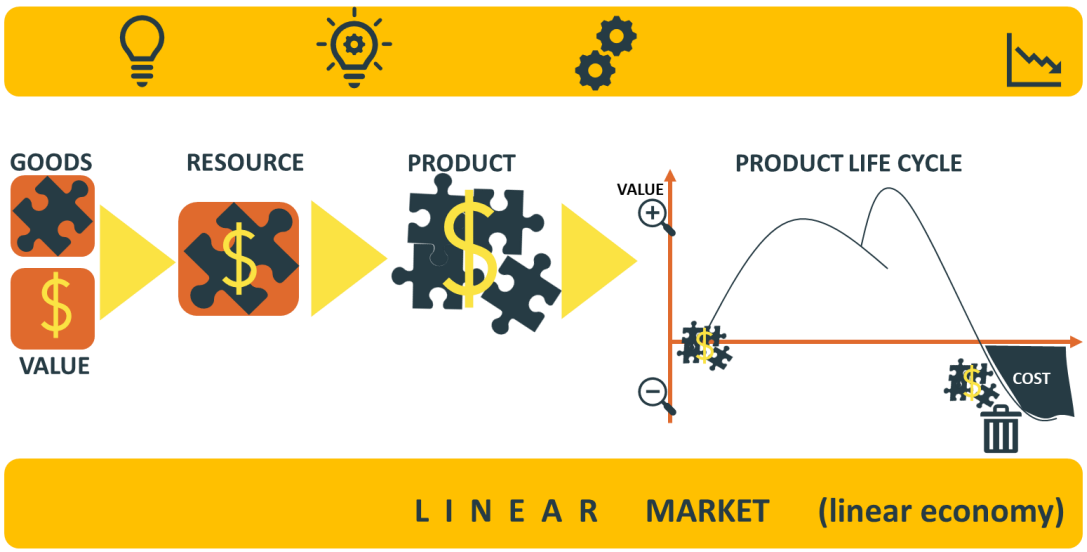
Mangla et al., 2018	+	+		+	+	+	+		+
Masi et al., 2018	+	+	+		+			+	
Preston, 2012	+	+	+		+	+	+	+	
Ranta et al., 2018				+	+				
Ritzén, Sandström, 2017	+	+			+	+		+	
Rizos et al., 2015	+	+	+	+	+		+		+
Tura et.al., 2019	+	+			+	+	+		
Vanner et al., 2014	+	+	+		+		+	+	+

Source: own compilation

The listed categories of barriers correspond to the problems that emerge during the transition to CE. The most common categories of barriers are: technological, economic, institutional and social. De Jesus and Mendonça (2018, p. 77) introduced an additional classification for the above barriers. They divided them into hard ones and soft ones. Hard barriers are related to techno-economic, and soft ones, have to do with regulatory and social issues.

The factor that determines the differences in identifying market failure in linear and circular economies is the relationship between resource, product and value. A resource is a good whose value is realized. The resource can be used in market processes by giving it the form of a market product. In a linear economy, during the transformation of resources into products, there is a transfer of value from the resource to the product. In other words, the creation of a product causes the disappearance of the resource. Products are subject to market mechanisms undergoing a classic product life cycle. This cycle can be extended relatively slightly. Nevertheless, the final result is the exclusion of the product from the market. A product outside the market loses its value. The product, therefore, becomes a cost to the economy, it is a waste. In summary, in a classical, linear market, we, therefore, have to do with: (1) the realization of the value of a good and the creation of resources, (2) the transfer of value from resources to the product category, (3) the loss of value due to the end of the product's life cycle. (Figure 8).

Figure 8. Value and resources in a linear market model



Source: own preparation

In the circular economy, the key difference is identified at the very beginning of the market process. A resource is also a good whose value is realized. However, during the inclusion of resources in market processes, i.e. during the transformation of resources into products, there is no transfer of value and thus loss of resources, but a commonality of value between the

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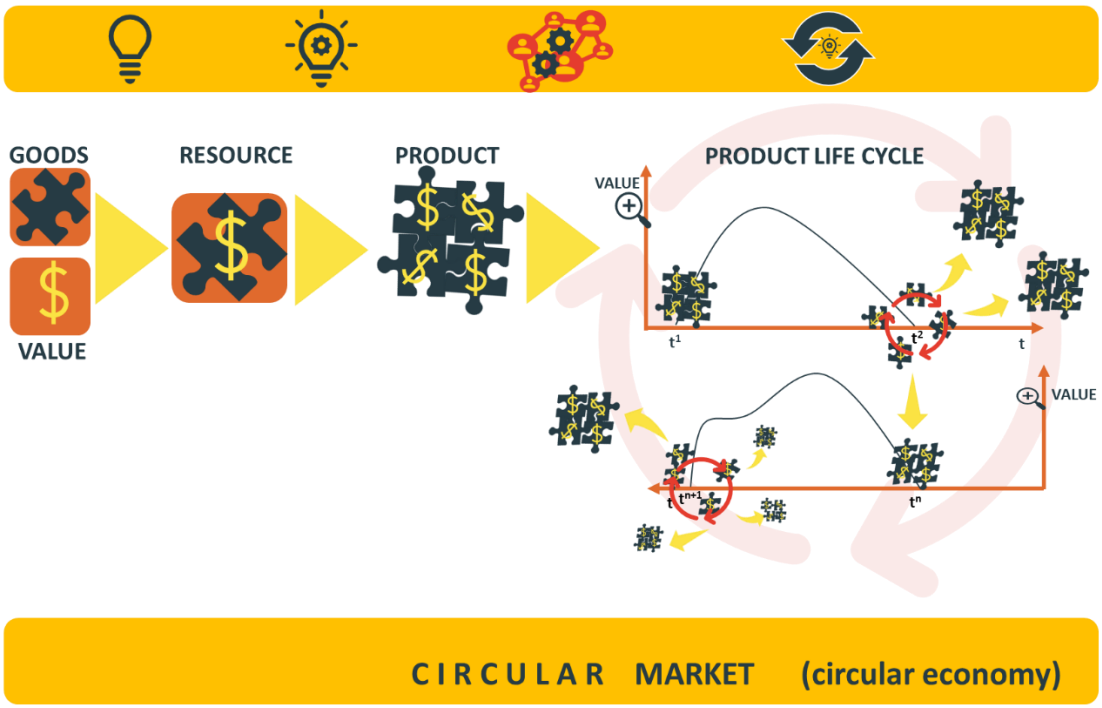
category of resource and product. This value is further enriched in the process of product creation. The original properties of the resource may also change. During the market process the resource functions in symbiosis with the product. At the end of the life cycle, the product disappears from the market, but without becoming waste (cost). End-of-life products release resources, often with changed properties from their original form. The new form of resources finds interest among subsequent stakeholders and market participants (Figure 9). Resources released back into the economy with modified properties are incorporated into the value chains of new sectors. Thus, a feature of the circular economy is the possibility of market cooperation between different sectors - building so-called industrial symbioses. It should be emphasized that the key condition for the launch of the circular market is the transformation of resources into products, without loss of resources (value transfer into products). Resources in the design of different products, with a different values, then participate repeatedly in market processes. As described in point 1 of this report, such symbiosis is possible to generate only with the involvement of all territorial partners: company, society, government and academy.

Figure 9. Value and resources in a circular market model



Source: own compilation

In the circular economy, the primary mechanism for regulating economic processes is the market. This market can also be distorted and market failures arise. A logical matrix was used to identify market failures in CE. The columns of the matrix indicate common categories of market failure. The rows use four basic categories of barriers identified during CE implementation:

- technological;
- economic;
- institutional;
- social.

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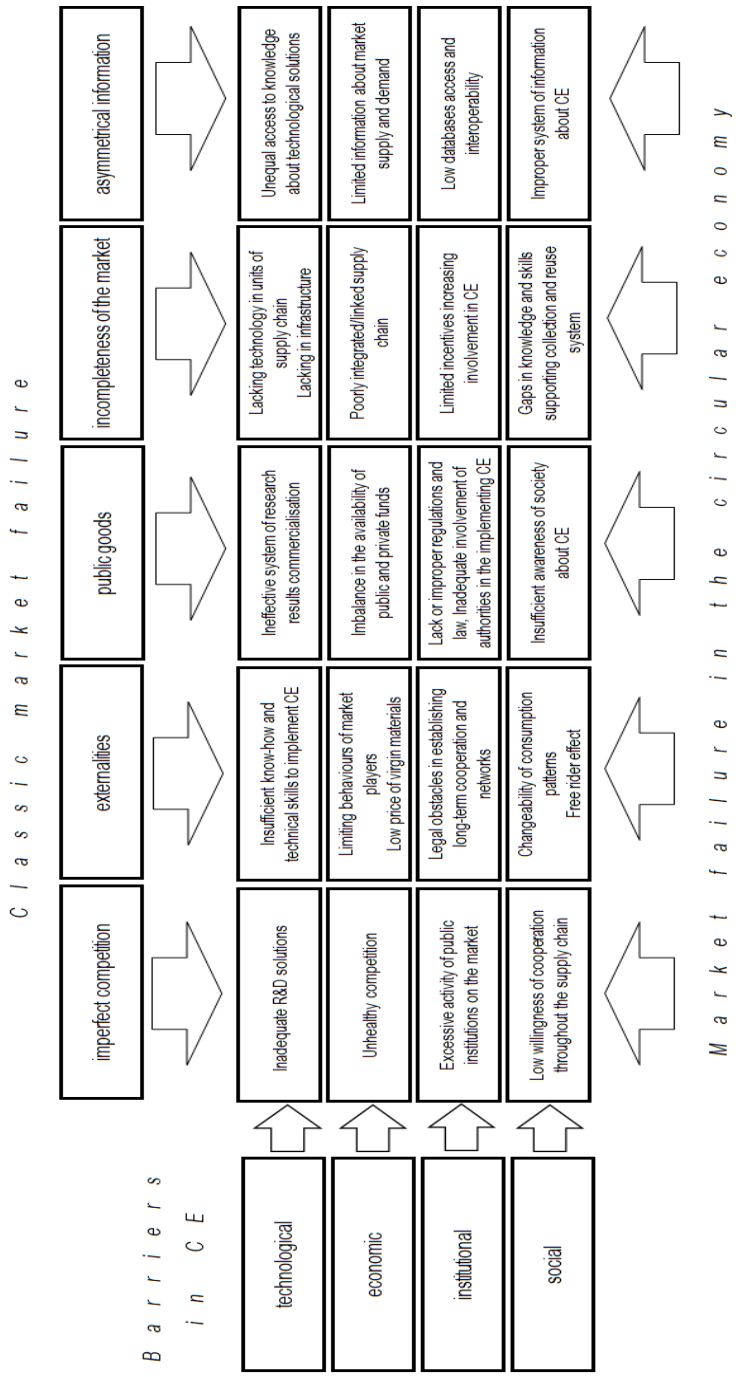
These barriers were identified in systems involving four stakeholder sectors for CE: company, academy, society and governance. Then, for each category of barriers, the types of market failures were identified. This matrix was used to construct the research tool described later in the paper. Although the neoclassical economy and circular economy represent different approaches to the market and its imperfections, there is a link between them. Barriers that occurred in CE can be identified with classic market failures (see Fig. 10). This clear connection between market failures and CE barriers was a starting point for our research.

Figure 10. Categories of market failure in circular economy



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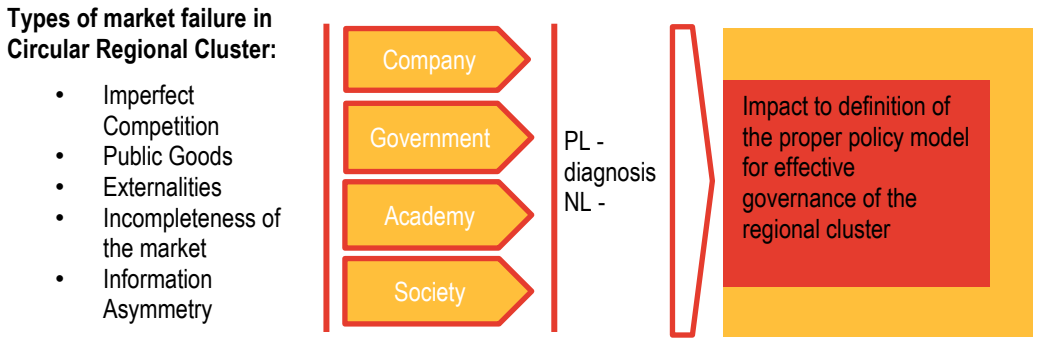
5.1.2. Methods of research

The research aimed to identify market failure in the circular economy and to assess the level of their occurrence in Lodzkie Region. To evaluate the existence of market failures in Lodzkie Region we made two assumptions:

For Lodzkie Region it is appropriate to investigate market failures in classical categories. The economy of Lodzkie Region is still "classical" and is in process of transition to CE. That is why, we decided to verify the existence of the following market failures: public goods, externalities, imperfect competition, incompleteness of the market, and asymmetrical information,

We consider Friesland region, The Netherlands1 as a reference group. It is because Friesland as one of the most circular regions in Europe should be treated as a pattern for other regions which want to be circular. The research was conducted among four groups: business, government, academia and society, who we consider as main actors in the market (Fig. 11).

Figure. 11. Logic and scope of the market failure in CRC research



Source: own compilation

For each group, we created matrixes, which show market failures from Fig. 7 in detail.

To achieve the aim, we conducted two-stage research:

1. Quantitative stage: Survey – online survey conducted among representatives of four mentioned groups (in total there were 8 surveys: 4 in Poland, 4 in The Netherlands). A separate survey sheet was prepared for each group. The survey respondents rated the level of occurrence of market failure on a 5-point scale. The selection of respondents was purposeful – specialists in the circular economy took part in the survey,
2. Qualitative stage: Focus Group Interview (FGI), as a survey, was conducted in Poland (May 2022) and in The Netherlands (April 2022) among representatives of mentioned groups, with the same respondents (in total there were 8 FGI: 4 in Poland, 4 in The Netherlands). FGI research allowed verification of survey results and their interpretation.

The research made in Friesland region and Lodzkie Region, let us compare the level of market failure occurrence in pattern region for CE (Friesland) and the region just implementing CE (Lodzkie Region).

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5.2. Results

5.2.1. Market failure in CE - Company perspective

Surveys conducted among business representatives indicated that the most noticeable market failure in Lodzkie Region is public goods (range on 5.0, Fig. 13). The least noticeable problem was asymmetry of information (range on 3.3, Fig. 13). In this case, too, the smallest gap was observed between Lodz and Friesland region.

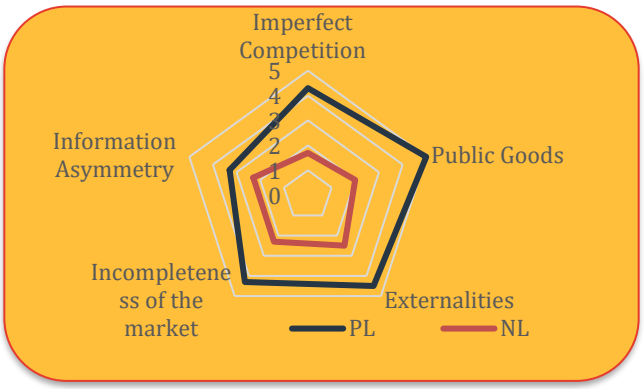

Figure 12. Benchmarking of CE market failures – companies

Figure 13. Market failures in CE: matrix for companies

Market participant:	COMPANY	Data:	NL: 26.04.2022 PL: 12.05.2022
Characteristics of the FGI research target group:	Companies – representatives of the CSSs: wood, plastic, water, food and other companies involved in CE (i.e. waste collection and recycling)		
Type of market failures	Question to identify market failure		Synthetic assessment of market failure occurrence
Imperfect Competition	▪ number of entities on the market ▪ type of relationship between market players (openness to cooperate) ▪ activity of public institutions on the market		PL 4,3 NL 1,7
Public Goods	evaluation of the regulations related to the activities of secondary raw materials market operators		PL 5,0 NL 2,0
Externalities	▪ consumption patterns ▪ cost-effectiveness of using secondary raw materials		PL 4,5 NL 2,5
Incompleteness of the market	▪ number of secondary raw material suppliers on the market ▪ availability of secondary raw materials on the market ▪ complexity of value chain ▪ the entry barriers to the market		PL 4,3 NL 2,3
Information Asymmetry	▪ utilities of data on the secondary raw materials market ▪ access to information on new techniques and technologies ▪ willingness of/ secondary raw material market actors to share knowledge and information		PL 3,3 NL 2,3

Source: own compilation.

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Entrepreneurs from the Lodzkie Region participating in the survey point out that the biggest problem is the existing legislation and the way it is interpreted and applied by public institutions. One respondent spoke of "beating their head against a wall due to existing legislative absurdities". They pointed, i.e., to the way tenders are prepared and awarded within the public procurement system. According to the respondents, public entities are favoured, making it difficult for private entities to compete with them. Another problem is i.e., regulations that obstruct to treat waste as a secondary raw material. A not insignificant factor is also the high level of formalisation of procedures, which forces entrepreneurs to spend a lot of time dealing with official matters.

Moreover, it has been emphasized that there is "collusion of companies" regarding offers when they join public procurements. As a result, a given market is serviced by, for example, one or two enterprises, which creates barriers to other entities from entering the sector. There is a lobby of current entrepreneurs that blocks other entities from entering the market at the level of enacted regulations. The other barrier in entering the market are high costs of technology, which are demanded in i.e., the secondary raw materials sector.

Interviewees indicated that cost-effectiveness of using secondary raw materials depends on their type. As a rule – virgin materials with simple ingredients are cheaper than secondary raw materials. So, the more complicated ingredient the more profitable is to use secondary raw materials. Of course, the quality of materials also matters. Entrepreneurs noticed that nowadays it is impossible to act without cooperation. Of course, such cooperation is not disinterested and consists primarily in the exchange of benefits, including information - one of the company's owners said, "if there is an interest to be done, we cooperate". However, it was said that "we cooperate, but do not share knowledge and experiences". Entrepreneurs from Lodzkie Region pointed out that incomplete and unreliable databases are not conducive to networking and cooperation. It is difficult to establish needs through and to monitor what other companies that could enter cooperation do and what raw materials they have. Understated information in databases contributes to further difficulties in planning the volume of waste, which does not always have much to do with reality, e.g., as a result of this, waste processing installations may only be created as much as indicated in the plan.

Situation of companies in Friesland region seems to look better. First of all, there are accelerators to help S&M companies that operate within the CE framework to stay in business. Although, operating in CE market “is not cheaper, but it is easier to get public funding”. Entrepreneurs noticed that networking (formal and informal), especially in the region or even on a smaller scale, is important in the functioning and development of their entities. Each company belongs to several associations and transparent platforms, which help them to exchange information, contacts, etc. Knowledge exchange and knowledge sharing are at a high level among competitors. It is worth to underline that in opinion of respondents financial or non-financial profit does not have to be visible immediately, but such an attitude brings long-term benefits. Entrepreneurs pointed to the noticeable barrier to entering the secondary raw materials market, which is incomplete information on raw materials (e.g., quantity, availability, quality at a specific time, etc.). This is in line with the opinion of entrepreneurs in the Lodzkie Region.

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5.2.2. Market failure in CE - Academy perspective

Academics in the Lodzkie Region identified externalities and incompleteness of the market as the most common market failures (3.5 and 3.3 respectively, Fig. 15). Imperfect competition was considered the least problematic (2.3, Fig. 15). Importantly, in this research group, the results obtained in both regions were the least divergent.

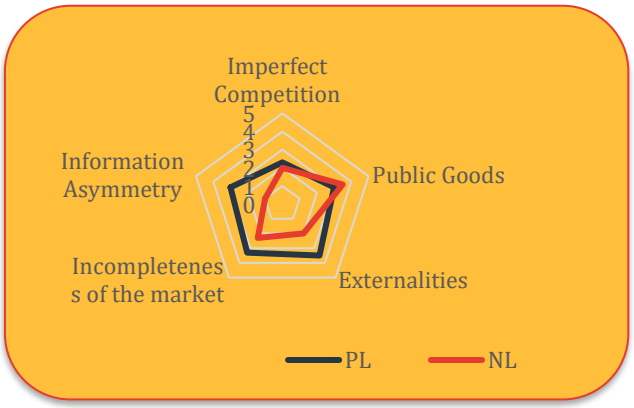

Figure 14. Benchmarking of CE market failures – academies

Figure 15: Market failures in CE: matrix for academies

Market participant:	ACADEMY	Data:	NL: 25.04.2022 PL: 09.05.2022
Characteristics of the FGI research target group:	Scientists involved in research of CE according with the CSS logic Administrative officer of R&D units according with the CSS logic		
Type of market failures	Question to identify market failure	Synthetic assessment of market failure occurrence	
Imperfect Competition	▪ competitiveness assessment of CE research ▪ participation of Circular Economy projects in the activities of the R&D units ▪ attractiveness R&D units for business	PL 2,3 NL 2,0	
Public Goods	▪ crowding out of private finance by public funds ▪ the scope for commercialisation of research from public funds	PL 3,0 NL 3,5	
Externalities	▪ formal barriers to the commercialisation process ▪ CE projects carried out in partnerships vs. individual projects ▪ synergy effects of partnership ▪ knowledge and technology transfer effectiveness ▪ profitability of CE projects ▪ staff transfer	PL 3,5 NL 2,0	
Incompleteness of the market	▪ implementation possibilities of realised projects ▪ the level of interest and absorption of the proposed solutions on the regional market ▪ absorption of R&D's projects related to CE in the region	PL 3,3 NL 2,3	
Information Asymmetry	▪ monitoring of market needs ▪ monitoring of business partners	PL 3,0 NL 1,0	

Source: own compilation.

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Respondents from the Lodzkie Region indicated that circular economy issues are very popular and current, and that undertaking research on this topic guarantees cooperation R&D institutions and enterprises. They also emphasised that it is easy to obtain funding (grants) for research in the field of CE, or to publish an article on this topic. According to the respondents, CE research requires interdisciplinarity. This necessitates cooperation, both between researchers from different scientific fields, but also with representatives of businesses and local governments. While cooperation with private entities was rated quite high, cooperation with local governments was rated low (often limited to mere declarations). Waiting for cooperation offers was considered a weakness of scientific units, which rarely initiate R&D cooperation on their own. Another problem of Lodzkie Region science institutions is the lack of the mentioned interdisciplinarity in CE research and specialisation in narrow research fields. Knowledge transfer was also considered an important element in CE research, as the exchange of knowledge, data, information increases the chances of finding and implementing new solutions. Unfortunately, its effectiveness was not rated highly by the respondents.

Also, Friesland researchers emphasised the interdisciplinarity of CE research. They also considered themselves to be interdisciplinary and saw their strength in this. This feature makes them an attractive partner for businesses. In addition, their attractiveness for business is strengthened by their extensive networks of formal and informal contacts. One effect of these contacts is the temporary transfer of academics into the business sector. According to the researchers, the essence of CE is to identify CE challenges, not only of a technological nature, but also of a social, managerial or economic nature (i.e., again interdisciplinarity). Knowledge transfer, which creates cooperation networks and allows the exchange of data and information, was also considered important. In contrast to the Lodzkie Region, cooperation with the local government was assessed positively. In Friesland local and regional governments are much more active, play the role of a facilitator, and indicate and encourage entry into CE projects. Importantly, the academics try to meet the needs of the local government and local entrepreneurs in both research and teaching activities.

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5.2.3. Market failure in CE - Society perspective

Study among representatives of society showed that in Lodzkie Region key market failures were incompleteness of the market and information asymmetry (both on 4,0, Fig. 17). The least problematic were externalities (range on 2,7). In this case the smallest gap between Lodz and Friesland regions were noticed.

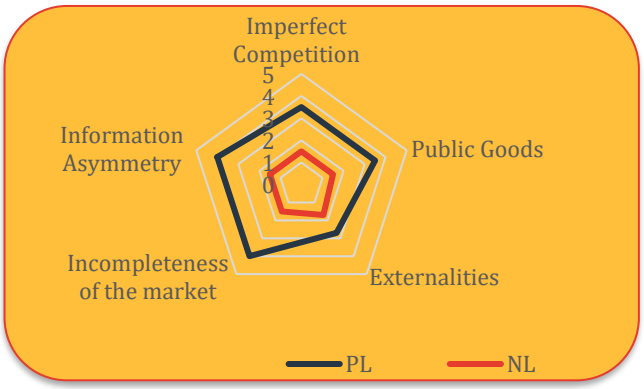

Figure 16. Benchmarking of CE market failures – society

Figure 17: Market failures in CE: matrix for society

Market participant:	SOCIETY	Data:	NL: 26.04.2022 PL: 09.05.2022
Characteristics of the FGI research target group:	representatives of NGOs, representatives of the social enterprise, local social leaders		
Type of market failures	Question to identify market failure	Synthetic assessment of market failure occurrence	
Imperfect Competition	▪ awareness of being a link in the value chain of industrial symbiosis ▪ cooperation between residents in CE	PL 3,5 NL 1,5	
Public Goods	▪ the social responsibility of residents as producers of waste ▪ evaluation of regulations on collection and use of waste	PL 3,5 NL 1,5	
Externalities	▪ benefits of participating in a recycling management system ▪ willingness to buy goods made from secondary raw materials ▪ free rider effect - gaps in the system of motivation and control of waste management	PL 2,7 NL 1,7	
Incompleteness of the market	▪ incompleteness of municipal recycling collection infrastructure ▪ gaps in the involvement of residents in waste management processes	PL 4,0 NL 1,5	
Information Asymmetry	▪ completeness of information on the waste collection system ▪ completeness of information on the waste reuse system	PL 4,0 NL 1,5	

Source: own compilation.

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Members of the society in Lodzkie Region are mostly aware of being part of the supply chain and often/eagerly are involved in additional ecological actions (among others: Earth Day, Cleaning the World, collecting bottle caps and papers). They evaluated themselves as an aware consumer. It seems that the major factors influencing their attitude are children and their future. On the other hand, respondents emphasised that they do not have complete knowledge regarding CE, i.e. the way of waste segregation. Respondents also indicated that the behaviour of their neighbours, who do not care about the environment, can be demotivating. They stressed concern that anonymity in crowded places (especially in block of flats) exempt some residents from being responsible and comply rules. According to one respondent, "an attitude persists in a large part of society: why make an effort if others don't do it anyway". Lack of information about the benefits of participating in waste collection and recycling, as well as incomplete information about it (i.e., collection dates and location) was also noticed. Society in the Friesland region is very dutiful when it comes to waste management issues. The awareness of the need to take care of the environment, also by sorting waste, is something the society of the Netherlands "suck from their mother's milk". Their awareness translates into openness and involvement in CE initiatives and activities proposed by public authorities or NGOs. Especially among the younger part of the population, it is popular to use second-hand products (i.e., clothes and home furniture) bought in shops or via online portals. Older people, on the other hand, are more involved in socio-educational activities, in which they try to share their knowledge and experiences of pro-environmental attitudes. This is important because, according to surveyed, "people think that using secondary raw materials results in a higher price for products made from them". So far, this is often true, but this will certainly change in the long term.

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5.2.4. Market failure in CE - Government perspective

From the perspective of region and local government study research expressed that in Lodzkie Region key market failures were externalities (on 5.0, Fig. 19). The least problematic were imperfect competition and incompleteness of the market (in order 3.2 and 3.3). In these cases, the smallest gap between Lodz and Friesland regions were noticed.

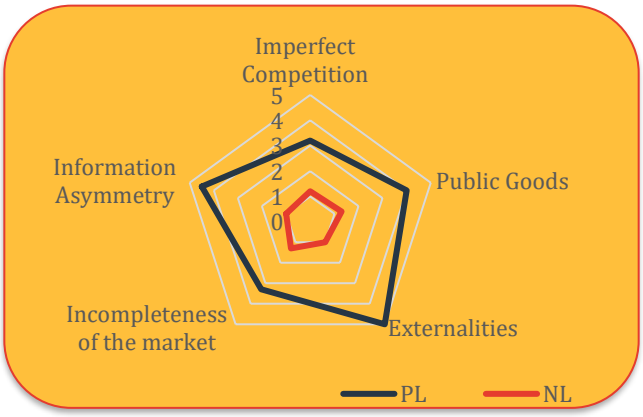

Figure 18. Benchmarking of CE Market failures – government

Figure 19. Market failures in CE: matrix for government

Market participant:	GOVERNMENT	Data:	NL: 25.04.2022 PL: 12.05.2022
Characteristics of the FGI research target group:	Representatives of the region and local government involved in planning, implementing and managing of CE Representatives of the institution supporting and controlling processes of CE in the region		
Type of market failures	Question to identify market failure		Synthetic assessment of market failure occurrence
Imperfect Competition	▪ number of operators in the municipal and industrial waste market ▪ competitiveness of public enterprises ▪ type of relationship between market players (openness to cooperate) ▪ compliance with current waste management rules by the public ▪ openness of society to new solutions in CE		PL 3,2 NL 1,2
Public Goods	▪ the role of the authorities in the market ▪ flexibility in decision-making by authorities ▪ evaluation of law regulations on the market of secondary raw materials		PL 4,0 NL 1,3
Externalities	▪ authority support for entering and existing market players ▪ behaviour of market players as market barriers ▪ the impact of existing regulations on the possibility of establishing long-term cooperation and networks		PL 5,0 NL 1,0
Incompleteness of the market	▪ number and type of market actors vs. level of need satisfaction ▪ adequacy of the offer of R&D on the market (availability of new solutions) ▪ the possibility of greater participation of residents in the market		PL 3,3 NL 1,3
Information Asymmetry	▪ willingness of secondary raw material market actors to share knowledge and information ▪ database interoperability		PL 4,5 NL 1,0

Source: own compilation.

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Representatives of the Friesland authorities emphasised that they see themselves as a booster for the functioning and development of the circular economy in the region. They try to stimulate entrepreneurs to be more circular. They are also a key link between the different actors in the circular economy market, creating a network and a platform for cooperation. For example, Circular Friesland Association and other dedicated information and education platform were established to serve this purpose. In addition, the governance is working to ensure that the implemented green procurement system contributes as much as possible to the circular value chain. More difficult and less precise regulations defining company waste were identified as a problem by the authorities. High awareness among the society can sometimes be a problem, according to the authorities. As an example, they cited a decrease in the number of domestic tourists who abandon their stay in accommodation establishments due to the lack of waste segregation. The regulations on the lack of waste segregation in accommodation establishments are due to insufficient knowledge of the segregation rules among some tourists. An important element in creating a circular economy in the region are institutions that support the creation and development of circular businesses. An example of this is, for example, BeStart - a start-up accelerator which helps circular start-ups in the north of the Netherlands to become successful.

Representatives of public authorities from the Lodzkie Region pointed to the problem of inadequate regulations governing the control of waste flows, resulting in the so-called "Polish-utilisation", i.e., abandoning waste in warehouses, burning it as a result of planned fires or placing it in mine pits. In addition, respondents pointed to the poor quality and inaccessibility and lack of interoperability of data bases. For this reason, it is difficult for public authorities to produce planning and strategic documents that meet real needs. An insufficient number of well-qualified staff in public institutions dealing with the circular economy is also a problem. According to respondents, the creation of a circular economy system is not facilitated by a monopoly of waste management actors who are not open to sharing knowledge and information with others. The cooperation between public authorities and R&D entities is also noteworthy. Authorities lack funding to subsidise CE research, and suggest that 'science needs to be opened up for local governments and other public institutions.

5.3. Conclusion

After the analysis of the collected material, differences are noticeable in the determinants of CE in the researched regions. The occurrence of market failures in CE was evaluated in the Netherlands at 1.76 on a five-point scale, while in Poland it was 3.71. The greatest differences in assessment were found in the group of public authorities and the smallest in the academies (Tab. 5).

In the Friesland region minor occurrence of market failures is a result of awareness all researched groups. Awareness of the need to move towards a circular economy is deeply rooted in Nederland's culture, education system and upbringing. Awareness of society (understand as residents, entrepreneurs, academics and representants of local and regional authorities or civil servants), which is built up for many years lead to creation of high-quality social capital. Naturally, existence of this social capital enhances additionally the awareness, so this is self-reinforcing process. The result of this capital and awareness is a mutual trust that fosters

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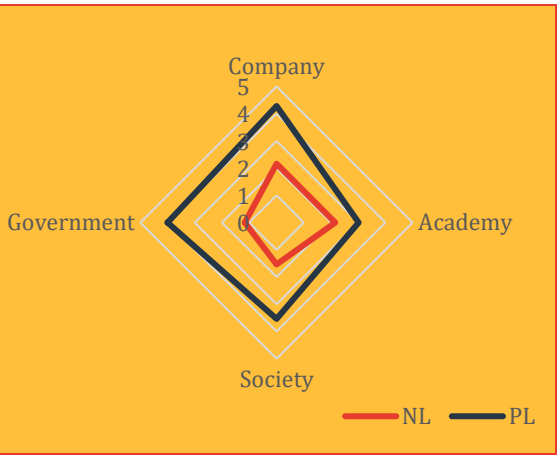
commitment to networking and building CE. It seems that networking is a key factor in Friesland's success in building a circular economy.

Table. 5. Compilation of market failures in particular research groups

Research group	NL	PL
Company	2,16	4,28
Academy	2,16	3,02
Society	1,54	3,54
Government	1,16	4,00
Average for region	1,76	3,71



Source: own compilation.

It seems that the Lodzkie Region is just at the beginning in building a circular economy. The region's weaknesses are primarily to be found in improper legal regulations and immature cooperation. The weakness of legal regulations is due to their high variability, the lack of precision, which allows for a great deal of arbitrary interpretation. As far as cooperation in the Lodzkie Region is concerned, if it does occur, it tends to be of a traditional and forced, rather than being the result of a well-thought-out strategy based on the benefits of the ecosystem and symbiosis. Networking is one of the crucial conditions for the construction and effective functioning of a circular economy cluster. As we mentioned, awareness of all actors is needed to build networking. In the Lodzkie Region this awareness is still insufficient.

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7. Identification incentives for creation Circular Regional Cluster

7.1. Methodology

7.1.1 Methods of research

Circular economy activities should be focused on eliminating the primary barriers, although this is often only a necessary but not sufficient condition for change to occur. there is a need to use incentives to provoke stakeholders to change and take action to implement a circular economy. Cambridge dictionary (2019) defines *incentive* as something that encourages a person to do something. Given that CE has such a wide variety of stakeholder groups involved, we assumed that *circular economy incentives* encourage all relevant stakeholders to implement circular economy into actions.

The study was conducted using a qualitative method, with three different research techniques. The first was the technique of overt participant observation, the role of the total observer was assumed (Babbie: 2004: 309, Marshall, Rossman: 1995: 60). The first observation was carried out on April 6, 2022, at the enterprise site of the "Eagle Pond" Municipal Waste Disposal Plant located in Prazuchy Nowe. all the important facilities associated with the site were visited. Additionally, we gained knowledge of the technologies and the overall idea of the plant's operation. During this time, photographic material was collected, documents and supporting materials were gathered, and discussions were held with key, and for the moment, potential respondents, who were then invited for in-depth interviews.

The second research technique was individual interviews with a standardized list of information searched for (IDI (Individual In-Depth Interview). The research tool was scientific and research dispositions, i.e. a list of information sought. Four interviews were conducted with key people on the issue of the circular economy. These were officials from the Department of Environmental Protection of the Marshal's Office of the Lodz Voivodeship, the Provincial Environmental Protection Inspectorate, the Orli Staw Municipal Waste Disposal Plant (ZUOK) and a representative of Ekotechnologie company. It should be noted that the respondents were treated as experts on the subject under study, and were selected in a targeted method.

The study also used qualitative data analysis, which consisted of the value of observations made through the use of participatory observation, content analysis of the materials collected and qualitative interviews conducted, as well as analysis of the literature on the subject (scientific articles, reports, EU studies), which indicated the current system of incentives within the implementation of the circular economy in the Lodzkie Region and beyond. The purpose of the study was to show the regularity of the phenomenon through the typical characteristics of qualitative data analysis: frequency, intensity, structure, processes, causes, and consequences of the process (Lofland: 1995: 127-145).

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7.1.2. State of the art

Typologies of incentives to CE. A literature review showed that incentives are a very important element in creating attitudes and behaviours of all relevant stakeholders to put into practice a circular economy. However, their effectiveness depends on many factors. According to the results of the literature review, the catalogue of incentives, both those operating currently and those potential, possible to implement, is very wide. For example, Whalen, Milios and Nussholz (2018) distinguished **initiatives that can support the circular economy**. They are:

- Take-back incentives,
- Monetary incentives,
- Mechanisms for reduction of labour costs (lowering labour taxes),
- Legislative, legal and regulatory frameworks,
- Extended Producer Responsibility,
- Tax incentives,
- Legal waste definitions affecting product end-of-life,
- Skills development (training and educational activities) - e.g. training for refurbishing,
- Obligations to provide spare parts,
- Obligations to provide product information for repairing, refurbishing, remanufacturing,
- Enforcement of longer warranty periods for consumers,
- Support circular economy innovative (focused business models),
- Development of infrastructure for consumers to hand in used products,
- Introduction of material efficiency and durability in product design regulation,
- Legal framework to facilitate the trade of repaired and refurbished goods,
- Reduction of value-added tax (VAT) for refurbished products.

Moreover, there is no single, generally accepted way of classifying (grouping) incentives. There are different categories, types, and groups. For example in *Policy Instruments and Incentives for Circular Economy - Final report 2020*, the incentives were categorized into main categories: technological, educational, social, regulatory, institutional, market conditions, fiscal, and industrial arrangements (Tab. 6). The distinguished categories of incentives are inseparable because they have in a common scope of influence. Such an example would be activities aimed at raising the awareness and/or knowledge of all stakeholders, which may be categorized as educational and social incentives.

Table 6. Typology of incentives in CE

CE Incentive category	Description
Fiscal incentives	This category includes fiscal incentives such as taxation, subsidies, financing, and internalising the cost of externalities. A starting point should be identifying and eliminating subsidies that are harmful to the environment.
Educational incentives	Incentives aim to increase knowledge and awareness of resource efficiency and circular economy. Education can raise awareness of the need for and benefits of

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	a circular approach as opposed to a linear approach to production and consumption.
Social incentives	Incentives and activities aimed at engaging consumers and the whole society in the circular economy. Awareness raising is an important area. Campaigns and other awareness-raising tools can be used to engage consumers more in the repair and reuse of products.
Regulatory incentives	Regulations related to the implementation of the circular economy. Examples are eco-design, waste and extended producer responsibility.
Technological incentives	Incentives aim to speed up the development of different technological solutions and innovations for the circular economy.
Institutional incentives	Institutional incentives include policy measures, strategies, and roadmaps that aim to promote circular economy implementation. The policy will have a key role in improving the handling of materials and implementation of circular economy principles.
Market conditions	Incentives create markets for secondary raw materials, repaired, reused and remanufactured products.
Industrial arrangements	These incentives refer to activities aimed to facilitate collaboration and partnerships in circular business. Enabling and rewarding value chain collaboration is needed to align the interests of partners.

Source: Policy Instruments and Incentives for Circular Economy - Final report 2020

The nature of incentives. In the literature also the nature of incentives has been considered. With regard to the way it works, incentives can be divided into direct and indirect. An example of a direct incentive is the price for waste collection calculated according to the method of its segregation, and an example of an indirect incentive is neighbourhood ostracism or the promotion of eco-shame attitudes due to the non-segregation of garbage.

Negative and positive incentives can also be distinguished. Positive incentives are, for example, price reductions on secondary products, and tax reductions. Negative ones, for example, penalties for inadequate waste collection and fees and restrictions on landfilling and incineration. In the literature Positive incentives are most often analysed, encouraging target groups to switch to a circular economy. Some incentives include both positive and negative aspects, e.g. deposit schemes can be voluntary but opting out would lead to a tax increase.

The psychological aspect of incentives makes it possible to distinguish incentives that appeal to two types of motivation (including the motivation to implement CE): altruistic and pragmatic. This division should be taken into account when formulating new incentives or addressing existing ones, since the correct appeal of altruism/pragmatism, can affect the effectiveness of their use.

The subjects of the incentive process are their senders and recipients (addressees). The senders of such incentives can be: EU, government, local government (regional or local). Recipients, on the other hand: entrepreneurs, institutions at various levels, residents. With regard to the scope of influence of the sender, incentives can therefore be divided into: operating at the EU level, national, regional, local. By the groups of addressees: into incentives aimed at a wide audience - society (e.g., general taxpayers, residents), and incentives aimed at specific groups of recipients, e.g., businesses in a specific industry, institutions with a specific profile of activity (e.g., schools/universities).

Considering incentives, their effectiveness is very important. The goal of the incentive process is to cause a change, an effect, in the form of implementing some action related to the

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circular economy. The effectiveness of incentives and the triggering of the so-called call to action depends on various factors. However, their list is not complete, and it is not possible to indicate either which of them are prerequisites or the minimum amount that would cause action. Nevertheless, it is important to realize that encouragement is a complex, conditional and contextual process. The success of the process depends, among other things, on the context (external conditions), the specifics of the sender, the recipient, the type of incentive, the choice of channel, and the correctly carried out encoding and decoding of the incentive. Many times it is difficult to clearly determine why a particular incentive does not work.

Based on the research, it can be concluded that the most important factors that can affect the effectiveness of incentives are:

1. Awareness and knowledge of incentives - it appears to be very important to recognize the message as an incentive, the so-called visibility of the incentive. In the mind of the individual, the incentive should be understood and defined as an incentive. In other words, the individual must correctly decode the incentive. This is not such an obvious process, given the differences and individual characteristics of the recipient - age, education, a social status held, personality predispositions, awareness, attitudes represented, sensitivity, attentiveness, etc.
2. The recipient's readiness to accept incentives - the lack of resistance and closure to accepting an incentive is important because it facilitates the process of perceiving the message as an incentive, and therefore its correct interpretation. This is also combined with knowledge and awareness of the importance of such an incentive.
3. Clarity of incentives (i.e., an orderly, consistent, accessible catalogue of incentives) - this point includes the phenomenon of bridging the barriers that, are strongly associated with incentives, and points to numerous inconsistencies and dispersion, thus weakening the accessibility of the catalogue of incentives.
4. Adequacy of incentives to conditions - to be effective in action incentives should be appropriate to the recipient. They should be properly coded with corresponding media. It is desirable when incentives are dedicated.
5. Articulating the incentive in the language of benefits - it is also very important in the incentive process to convince the recipient that implementing the incentive 'pays off', and therefore to see the benefits in action (in the near or long term). In the case of the circular economy, mainly pragmatic motivations are important, and in the case of entrepreneurs, financial ones.
6. Balance between encouragement and punishment (positive versus negative reinforcement) - it is important to maintain a balance between reward and punishment. Attention should also be paid to the intensity and impact of both. The proportion between the use of penalties and rewards in the system, however, should add up in favour of incentives. Furthermore, the reward (for implementing the incentive) should not be overly deferred. If it is, it should be greater.
7. Awareness of the "devaluation" of incentives - there should be constant monitoring of the effectiveness of incentives to update information on the system in place. " Custom", familiarity with incentives, can cause them to lose their attractiveness.

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Incentive communication models. The effectiveness of incentives depends on how they are communicated. These ways can be analyzed using communication models. Efficient communication of incentives is essential in order for them to reach their potential target audience.

The process of incentivization, i.e. the sending and receiving of incentives, can be presented using and analogous to the communication models functioning in the literature (Griffin, 2000, Dobek, 2002, Drzazga, 2004). The stakeholders of the change - and thus the actors of the "encouragement" process will thus be respectively: Sender (Source) and Recipient (Audience), and the message will be equivalent to a particular incentive (Fig. 20).

Figure 20. Basic model of one-way communication

Source: own compilation based on Lasswell, 2015.

It is worth mentioning that communication is a process of interaction between different social actors, implying exchange, communication, being in contact, and transferring information and knowledge. At the same time, it is a complex and dynamic process, and not a one-off. Communication takes place at many levels and levels, using a variety of channels and media. This process is carried out in a rapidly changing market environment. In addition, communication can be influenced by a variety of noises and distortions, the consequence of which is the possibility of disharmony in the transmitted, encoded and received function. The communication process closes with a 'feedback' loop, expressing the recipient's response to the sender's proposal. The communication process, understood in this way, can be applied to the process of sending and receiving incentives (Fig. 21).

Figure 21. Encouragement model based on the one-way communication model

Source: own compilation based on Lasswell, 2015.

The different elements of the communication process (concerning the sending and receiving of circular economy incentives) are outlined below. In this case, we are talking about two-way communication, which is a two-way flow of information both from the sender to the receiver and through feedback from the receiver to the sender. The recipient's response is usually delayed in time. The basic issue is to answer a series of questions that form the communication process: Who? What? How? To whom? With what effect? Here is what goes into the encouragement process:

- CONTEXT (EXTERNAL CONDITIONS)/SURROUNDING)- is a set of conditions in which communication takes place, often taking the form of subjective (contextual) conditions. These can be conditions: social, cultural, economic, legal, specifics of the place, functioning barriers, and social norms. It is the outermost, most general area in which the encouragement process takes place.
- SPECIFICITY OF THE TARGET GROUP/ RECIPIENT - in the process of encouragement it is necessary to take into account the specifics and characteristics of the

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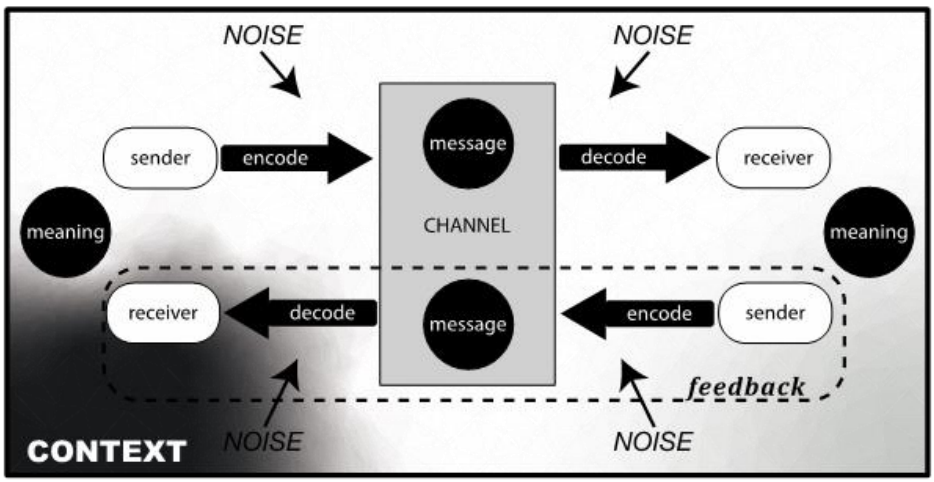
recipient, which can significantly affect the reception of incentives. Specifics will be influenced by certain factors, e.g.: level of awareness, attitude, the experience possessed, knowledge, intentions, personality traits (conscientiousness, openness to new experiences, neuroticism, extroversion/introversion, agreeableness), willingness to listen, the existence of prejudice or their lack. Considering the community, it could be the group's predisposition to change habits, level of openness, type/size of the community, values held, level of human/social capital, etc., level of social control, emotional filters: and here are the strongly influential category of shame, etc.

- SENDER SPECIFICITY - is shaped by factors, i.e., maturity, readiness, experience, use of strategies, mission/vision, possessed knowledge, intentions/willingness, induced trust or lack thereof, credibility, signal consistency, etc.
- COMMUNICATION - specific content that is communicated and goes from the Sender to the Recipient.
- CHANNEL OF COMMUNICATION - the means and channels by which the content is transmitted (the incentive is communicated). It is the way the content goes from the sender to the receiver.
- CODING/DECODING - these processes are a very important part of the incentive. The correct encoding of the incentive by the Sender determines whether it will be decoded and understood by the Recipient, and therefore whether the encouragement process will be successful.
- SPREADS - factors that interfere with the message and/or reception of an incentive, e.g.: information overload, differences in perception, status, or power.
- REFLECTIVE SPEECH - the Recipient's response to the type of incentive directed to him/her.
- MEANING - a key element in the process of sending and receiving incentives is their correct and adequate understanding, both at the level of their encoding by the Sender and decoding by the Recipient. This stage can be considered the most important principle of the entire process.

Figure 22 shows the two-way communication model with all its components.

Figure 22. Two-way communication model.



Source: own compilation based on Griffin, 2007.

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The models used in the formulation of circular economy incentives, can present themselves differently, and take different forms.

There are 6 types of models of incentive (communication) processes:

1. One-way and two-way communication model: one Sender, one Incentive, one Recipient

Figure 23. One-way and two-way communication model. Source: own compilation.

2. Mass communication model: one Sender, one Incentive, several Recipients

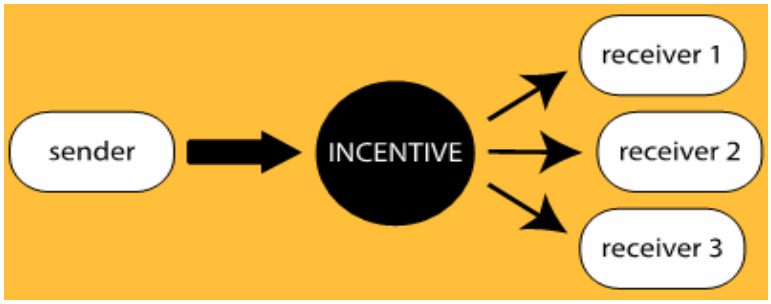

Figure 24. Mass communication model. Source: own compilation.

3. Sector Communication Model: One Sender, One Incentive, Recipient Sectors

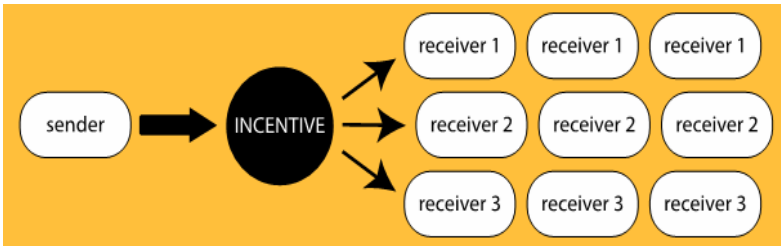

Figure 25. 1.One-way and two-way communication model. Source: own compilation.

4. Multiple Sender Communication Model: multiple Senders, one Incentive, One Recipient

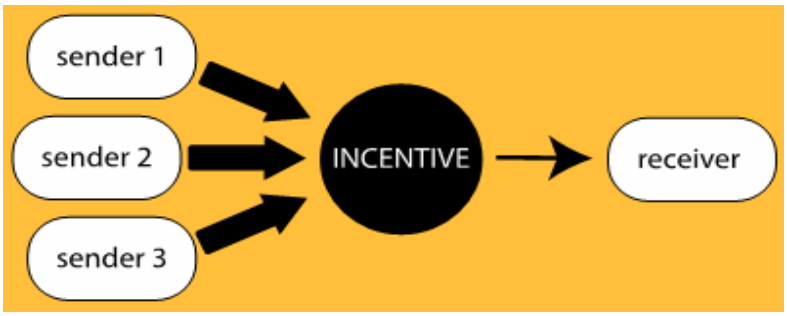

Figure 26. Multiple Sender Communication Model. Source: own compilation.

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5. The communication model of the plurality of Senders and Incentives: multiple Senders, multiple Incentives, one Recipient

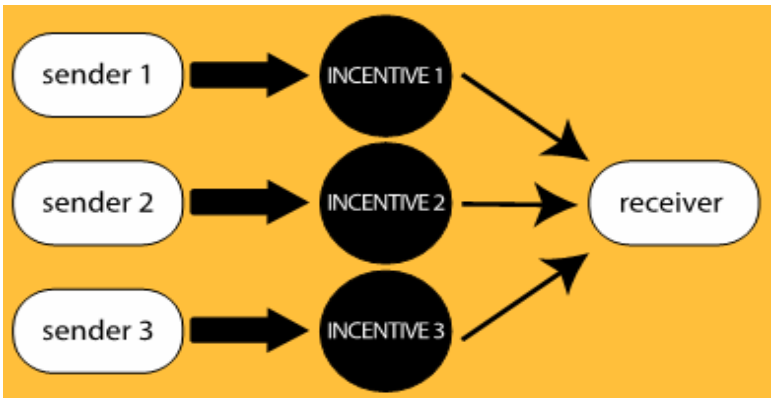

Figure 27. The communication model of the plurality of Senders and Incentives. Source: own compilation.

6. The Communication model of the plurality of Incentives: One Sender, multiple Incentives, one Recipient

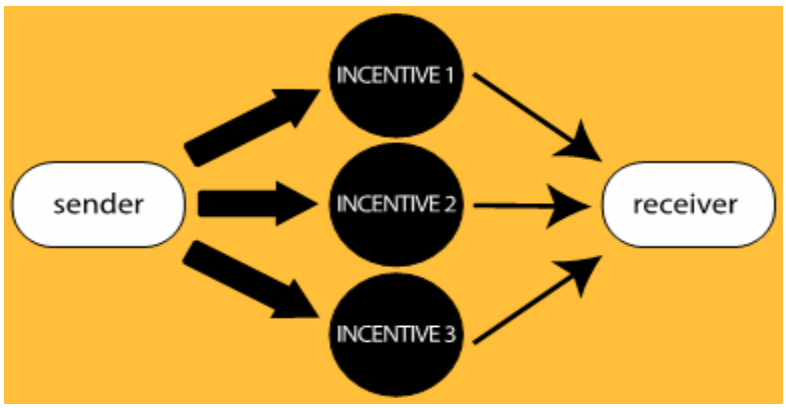

Figure 28. The Communication model of the plurality of Incentives. Source: own compilation.

Given the above, research questions were formulated:

1. What models of formulating incentives (analogous to the course of the communication process) can be observed in the 4 groups of the circular cluster in the Lodzkie Region?
3. How does the selection of forms, methods, channels and content of the message present itself in each group of stakeholders?
4. What is the readiness of Recipients to accept the incentive?
5. What is the efficiency of the identified models?
6. Are the incentives perceived as incentives?

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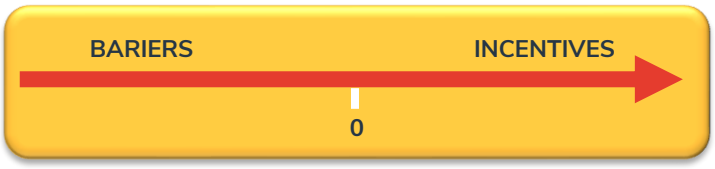
7.2. Results

7.2.1. Available incentives in the CRC

According to the results of the literature research, incentives are often presented as opportunities related to solving barriers to the implementation of a circular economy, either systemic in nature or sector-specific. Related to this are the recognised barriers to CE implementation: the lack of clear incentives, complex and overlapping regulations as well as the lack of governmental support. Therefore, circular economy implementation efforts should target both incentives and the elimination of key barriers. Many incentives can be viewed as the opposite of barriers. If, for example, lack of knowledge about the circular economy is a barrier then promoting this knowledge can be seen as an incentive. Therefore: no incentives may be barriers, but no barriers are too little to be an incentive. It is only the starting point on which an incentive can be built.



The factors that have the greatest impact on the implementation of the circular economy include: awareness of market participants, knowledge (skills gaps), resources (financial), technological challenges (adaptation and innovation) and legal solutions. In these areas, barriers must be both removed and incentives created.

However, legal issues are considered to be the most effective incentives (legislation and the changes taking place in it should be considered both as a trend and as conditions for the implementation of the circular economy). Awareness barriers are also no less important, however, mainly those related to the level of knowledge. To benefit from a particular incentive, one must be aware of it. Another awareness issue is also the attitude to the incentive related to the internalization of a given norm, the realization of which the incentive is supposed to serve (internalization of the norm can be the basis for, for example, eco-shaming).

The conducted research made it possible to distinguish a list of incentives operating in the Lodzkie Region, divided into the groups proposed in Table 7. To systematize and hierarchize the very broad and diverse catalogue of incentives to the already discussed division into groups (level I), additional levels of categorization were introduced: type of incentives (level II) and detailed solutions (actions/legal standards/administrative rule) (level III). Each also specified the sender and communication model used (Tab. 7).

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Table 7. Categories and types of CE incentives in relation to Sender, Recipient and Model

Recipient:	**Society/ Company/ Academy/ Government**			
Identification of the incentive:			Sender: level of government: Local/ Regional/ National/ UE	Recipient: Communication models
CE Incentives category	Type of incentive	Detailed Solutions (actions/ legal standards / administrative rule)		
Fiscal (Financial)	Changes in taxation system	At the request of the entrepreneur the possibility of a payment in instalments (in exceptional cases, even remission) of the so-called environmental fee (fee for use of the environment) which is a form of tax collected by the Marshal's Office	Regional	CM2 CM3
	Targeted subsidy system	System of grants and loans of the WFOSiGW for the implementation of tasks related to environmental protection, including tasks aimed at the development of CE. Individuals, entrepreneurs, social organizations, local government, and state budget units can apply for grants and loans. The condition is the presence of the task in the priorities established for a given year in a resolution of the management of WFOSiGW For example, state budget units for environmental education, development of provincial environmental protection programs and waste management plans, as well as support for the implementation and control system for these programs and plans can receive 90% funding, and projects related to the implementation and operation of the eco-management and audit system (EMAS) * - 40% (Resolution No. 9/II/2022 - Principle of granting financial assistance from the funds of the WFOŚiGW in Lodz)	Regional (WFOSiGW)	CM2 CM3
		A system of preferential loans granted to entrepreneurs, institutions, local governments and individuals by the Bank for Environmental Protection for purposes in line with CE (loans co-financed by government programs or WFOSiGW funds)	National	CM2 CM3
		A system of grants and loans provided by NFOSiGW through provincial funds (e.g., funding for ETV environmental technology verification)	National (NFOSiGW) /Regional (WFOSiGW)	CM2 CM3
Educational	Support of involved in the implementation of CE	Development and realization of training systems preparing for the implementation of CE activities for officials and activities covering part of the cost of consulting on the implementation of CE-compliant solutions in enterprises (e.g., GreenEvo - Green Technology Accelerator - a	National	CM2 CM3 CM4

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		project of the Ministry of Climate and Environment supporting the development of environmental technologies at home and abroad, offered by Polish entrepreneurs. As a result of joining the program, companies gain, among other, knowledge of available support instruments, marketing support, the opportunity to participate in foreign economic and trade missions or a series of specialized training courses on sales and presentation techniques, building export strategies, acquiring funds for R&D or patent protection		
	Raising the level of knowledge	Development and implementation of reward systems for CE knowledge (knowledge competitions, Olympiads, etc.), organized by individual local governments with funding from WFOSiGW of up to 90% of the cost (e.g., the "Second Life of Waste" competition funded by WFOSIGW in Lodz)	National /Regional /Local	CM1 CM2 CM3
		Promotional and information campaigns to raise awareness of CE (picnics, information materials e.g. information brochures, leaflets, educational videos issued by the Marshal's Office and by individual local governments), eco-education for children and schoolchildren organized by the WIOŚ	Regional /Local	CM1 CM2 CM3
		The provisions of the WPGO, which emphasize the need for environmental education on waste reduction	Regional	CM1 CM2 CM3
Technological	Support of technological innovation	Support for the purchase and implementation of new technological solutions used in CE (through, for example, GreenEvo - Green Technology Accelerator)	National	CM1 CM2 CM3
		Support in the certification process, e.g. funding for environmental technology verification (ETV) provided by NFOSiGW	National	CM1 CM2 CM3
	Support business models focused on CE	Support for the purchase and implementation of new business solutions that meet CE goals through the GreenEvo - Green Technology Accelerator project	National	CM1 CM2 CM3
Social	Support the involvement of businesses and consumers and society as a whole in the CE.	Bottle machine system (e.g. Bottle machine in Manufaktura - collecting points exchanged for Manufaktura letters). Currently individual cases at the level of information only	Local	CM2 CM3
		Social initiatives: the Foodsharing Room	Local	CM2 CM3
		Publicity and information campaigns aim to consolidate CE-compliant behaviour, showing its social and individual benefits	Regional/Local	CM2 CM3
		Replacement of public trash garbage cans with those prompting waste segregation	Local	CM2 CM3

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		Setting up containers for hazardous waste (batteries, fluorescent tubes, medicines)	Local	CM2 CM3
	Raise awareness of the opportunities that exist under CE and their benefits	Pro-environmental actions promoting behaviours consistent with CE goals (type: waste segregation) among various stakeholders (e.g., study visits, good examples, promotion of eco-shame)	National/ Regional /Local	CM1 CM2 CM3 CM4
		Shared residential responsibility for waste segregation - community control of each other	Local	CM1 CM2 CM3 CM4
		Organization of competitions, such as: Stena Circular Economy Award - purpose: to promote companies that implement or promote the circular economy, to support students who have an idea to promote or implement CE to society or business (competition categories: Companies implementing CE, Companies promoting CE ideas, Students with an idea to promote or implement CE).	National	CM1 CM2 CM3 CM4
		Organization of forums, conferences, debates:, e.g.: on September 30, 2021, the 2nd Business and Sustainable Development Forum - Lodz 2021 was held	Regional	CM1 CM2 CM3 CM4
Regulatory	Regulations related to implementation of CE	Law of September 13, 1996 on **maintaining cleanliness and order in municipalities** (Journal of Laws of 2020, item 1439), defines: – the tasks of the municipality and the obligations of property owners concerning the maintenance of cleanliness and order; – conditions for carrying out activities in the field of collecting municipal waste from property owners and managing this waste; – conditions for granting permits to entities providing services within the scope regulated by the Law. An important aspect regulated by the Law is the determination of the minimum levels of recycling and preparation for reuse of municipal waste that municipalities should achieve in subsequent years: 50% by weight - for each year in 2020-2024, 55% by weight - for each year in 2025-2029, 60% by weight - for each year in 2030-2034, 65% by weight - for 2035 and each subsequent year. Law of December 14, 2012 **on waste** (Journal of Laws of 2020, item 797, 875) introduces the principles of waste cataloging, including the responsibilities of waste holders. It also defines the waste treatment hierarchy, from the most desirable prevention to disposal. In relation to the waste hierarchy, the law also introduces the proximity principle, according to which waste is first **treated** at the place of its creation.	National	CM1 CM2 CM3

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		Law of June 13, 2013 **on packaging and packaging waste management** (Journal of Laws of 2020, item 1114) specifies: – the requirements to be met by packaging placed on the market; – principles of operation of packaging recovery organizations; – principles of dealing with packaging and packaging waste; – the rules for determining and collecting the product fee and recycling fee. The goal is to reduce the amount and harmfulness of packaging to the environment, including at the stage of its production, use as well as after its lifetime. The law sets standards for harmful materials and substances. It also imposes an obligation on those introducing packaging to the market to design and manufacture it in such a way that it can be reused and later recycled (or otherwise recovered) Law of July 19, 2019 **on preventing food waste** (Journal of Laws 2019, item 1680) specifies, among other things: – the obligation to donate unsold food - stores affected by the Law are required to sign an agreement with an NGO of their choice to which they will donate unsold food; – food waste fees - if unsold food is not donated to an NGO, the food seller is obliged to pay a food waste fee, which is transferred to the NGO or to the WFOSiGW; – NGO reporting obligation - to submit annual information on how the food received is managed and how the funds from the fee are used; – vendor reports on wasted food - including data on the total weight of wasted food in a given year and the amount of the fee due; – sanctions for failure to comply with reporting obligations, failure to pay the fee, or failure to enter into an agreement with the NGO.		
		The Database on Products and Packaging and Waste Management (BDO) established under the provisions of the Waste Act of December 14, 2012 in 2018. Its part is the register of entities introducing products, packaged products and waste management. As of 01/01/2020, further modules of the database have been launched, i.e. the records module and the reporting module. BDO enables comprehensive collection and management of information on waste management and provides entities with fully electronic implementation of registration, record-keeping and reporting obligations.	National	CM1 CM2 CM3

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		Certification and standardization of products, semi-products and raw materials, through which an entrepreneur can be sure that the goods and services used in its production have the right properties to guarantee its proper handling of waste. Such tools include commercial certifications (e.g. BREEAM and LEED in buildings), as well as those developed by the public sector, e.g. Environmental Technology Verification (ETV). The introduction of some of these standards is being financially supported.	National	CM1 CM2 CM3
		Roadmap for Transformation to CE (document adopted by the Council of Ministers in 2019). In particular, the requirements contained therein include raising recycling levels for municipal waste to 55% in 2025, 60% in 2030 and 65% in 2035. The high targets also apply to packaging, with 65% recycling to be achieved in 2025 and 70% in 2030. 70%. Modifications are pointed out to the waste regulations currently in force in Poland. In particular, reference is made to more clearly defining the roles and responsibilities of the various entities participating in the implementation of Extended Producer Responsibility (EPR), setting new targets for preparing for reuse and recycling of individual waste streams, developing a system for reporting the implementation of EPR, or ensuring that the system treats all businesses the same	National	CM1 CM2 CM3
		Collection of information on the number of green public procurements by the Public Procurement Office. Changing the Public Procurement Law in the context of introducing the possibility of implementing Green Public Procurement in terms of description and criteria	National	CM1 CM2 CM3
		The inclusion of content on CE in the current SRWŁ, a regional legal act, is a change in approach from previous editions	Regional	CM1 CM2 CM3
		Increase in the capacity of the WIOŚ to act as an anchor body for the implementation of regulations under environmental laws (by extending working hours, and strengthening personnel), with the assumption that the desire to avoid a potential penalty acts as an incentive	National	CM1 CM2 CM3
		Inclusion in the draft ROP WŁ of activities dedicated to CE, financed from the ERDF	UE/National	CM1 CM2
		EU Parliament and Council Directive 2019/904 on reducing the environmental impact of certain plastic products	UE	CM1 CM2 CM3 CM4 CM6

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	Regulations financing of CE	Investor Support Point - assistance to investors whose area of activity, in particular, falls within one of the following industries: modern textile and fashion industry (including design), advanced construction materials, medicine, pharmacy, cosmetics, energy, including renewable energy sources, innovative agriculture and agri-food processing, IT and telecommunications. Support assumes: exchange of information, collection, analysis, creation and sharing of databases, project cooperation, cooperation with partners, bilateral meetings, study visits, economic missions, participation in trade fairs, business support, analysis of EU legislation (https://bruksela.lodzkie.pl/punkt-wsparcia-inwestora/)	National	CM1 CM2 CM3 CM4 CM6
Market in centives	Support the creation of markets for secondary raw materials	Activities of the program support the so-called "repair cafes". Under the slogan NaprawiaMY with Veolia, the program has helped establish 16 cafes in Lodz. Repair cafes are initiatives to collectively and for free repair things that would be dumped for lack of a chance for a second life (this includes clothing, household appliances, furniture and bicycles)	Regional/ Local	CM1 CM2 CM3 CM4 CM5 CM6
		Functioning of repair shops at RIPOKs (Regional Installations for the Processing of Municipal Waste)	Regional/ Local	CM1 CM2 CM3 CM4 CM5 CM6
	Support for the creation of markets for repaired, reused and remanufactured products	Functioning of the market for second hand stores	Local	CM1 CM2 CM3 CM4 CM5 CM6
		Online platforms for exchanging, buying, selling used goods: vintage, olx	National/ Regional/ Local	CM1 CM2 CM3 CM4 CM5 CM6
		Organization of events like "antique market, flea market"	Local	CM1 CM2 CM3 CM4 CM5 CM6
		Implementation of European projects by the Lodzkie Region, e.g. SCREEN ("European regions for synergy in the circular economy").	UE/ Regional	CM1 CM2 CM3 CM4
		Setting up centers for CE initiatives: Innovation and Technology Transfer Center, Medical University of Lodz. It supports new business ventures while providing administrative support at all stages of commercialization. Ecology Center:	Regional /Local	CM1 CM2 CM3 CM4

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		an informal initiative for reducing waste to zero and for health. It is an initiative of local and regional NGOs, businesses and researchers for CE		
Institutional	Policy measures, strategies and roadmaps to promote the implementation of the CE	Including in the List of WFOSiGW Priority Projects for 2021 (Resolution No. 50/VI/2020): selective collection points for municipal waste, facilities for purification of selectively collected waste fractions, installations for recycling of individual material fractions, removal and disposal of products containing asbestos	Regional /Local	CM1 CM2 CM3 CM4
	Support for the creation of new concepts for transition toward CE implementation	Setting up by the Marshal's Office of the Entrepreneur Service Center aimed at helping with the application for ROP funding.	Regional	CM1 CM2 CM3
Industrial arrangements	Support for the new organizational forms in inter-firm cooperation based on industrial symbiosis	lack	-	-
	Facilitating cooperation and partnership in the CE sector	lack	-	-

Source: own compilation.

7.2.2. Identified communication patterns of incentives

The identified six models of the process of giving and receiving incentives for CE implementation will be used to precisely identify this process and its main elements and actors using the example of already specific categories and types of incentives (see Table XYZ). The fifth and final column of the table indicates which incentive model we are dealing with,

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concerning the already defined incentive listed in the row. The sender formulating the incentive will be the Government, from the level of local, regional, national, and EU. On the other hand, the recipient of the incentive is mainly Company and Society, and marginally Government and Academy. It should be mentioned that each incentive indicated in the table forms a single incentive process, fitting into a specific model with individual and inherent conditions (context, understanding, channel, noise, and feedback).

7.3. Recommendations to improve the system of functioning of incentives directed to entrepreneurs in the opinions of surveyed experts

According to the experts surveyed, the issue of incentives, i.e. the formulation and implementation of various instruments and forms of support for CE activities, is an interdisciplinary topic, and one in which, as a country (even more so - a region), we are just gaining experience. Respondents unanimously stated that knowledge acquired during studies (e.g., in the field of environmental protection), many years of professional practice in the field of CE, collisions with real problems and solving them (e.g., in the process of running one's own business), support from other experts, participation in courses, training, conferences, as well as spontaneous search for information makes it possible to find oneself more efficiently in the CE subject. This does not guarantee the overall feasibility of the circular economy assumptions. The problem of functioning barriers also continues to resound as one that coexists with incentives. Respondents repeatedly found it difficult to abstract from perceived barriers in the system (from the EU, national, regional, or local level) when it came to speaking about incentives. The circular economy was defined through such accompanying terms as resource efficiency, low carbon, "second life," cycle, consumer reflection, awareness, raw materials, care, and change. Incentives themselves, on the other hand, were understood as support; something that causes a person to acquire the desire to do something; as a financial or non-financial benefit to improve the quality of some action.

General comments formulated by experts around the issue of incentives. The comments discuss social, legal, research and financial aspects:

1. The role of awareness in the implementation of CE: awareness issues were present at almost every stage of the expert interviews conducted.
2. The importance of legal aspects in implementing CE: incentives are often considered in connection and conjunction with barriers. For some respondents, working to level barriers, is only the beginning of building incentives. There is no freedom and peace of mind in implementing the incentive process if barriers effectively impede or even prevent action. The most important formal and organizational framework for CE activities, is considered to be the law. Functioning within the legal framework, and the daily struggle with its interpretations, is not an easy matter for either entrepreneurs or local government officials. The dissonances that arise on this topic, which the surveyed experts mentioned, are:
   - inconsistencies and inaccuracies in legal regulations;

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- the scattering of laws and the difficulty of finding and codifying them, so being up to date requires a great deal of effort and attentiveness;
- making changes to laws that do not entail other necessary changes;
- emerging gaps in the consistency of national regulations with the EU;
- lack of knowledge of how to interpret and implement regulations, making them difficult to read;
- divergences in defining important conceptual categories, e.g.: "biomass" has a different definition in national legislation and another in the EU;
- co-occurrence of competing interpretations of a given regulation, or legal provision, which consequently leads to different enforceability;
- lack of a rational approach in the creation of legislation - space for many absurdities and contradictions.
- sloppiness in legal regulations.

Legal issues are considered fundamental, so an unquestionable incentive would be to resolve the above issues, which, unfortunately, according to the respondents, does not appear to be easy and quick. Legal barriers to this take away the effectiveness and efficiency of the incentives that are built upon them.

- The importance of partnership between the company and the university in the implementation of CE - the experts surveyed see in the cooperation of business and research centers (mainly those of a technical nature), the future of CE functioning. The cooperation would consist not only of knowledge transfer, exchange of good practices, but also technology and opportunities to use equipment, laboratories to test CE solutions. It is this kind of cooperation that results in innovations: social, process, organizational, etc. According to some opinions, loans from the Provincial Fund have a low interest rate: 2-3%, while participation in projects (business and university), e.g.: from NCBR gives a chance for 40 or even 50% funding, which is already a significant difference. Thus, it is important to build a network of relationships, and mutual support, as well as to seek beneficial and mutual solutions.
- The importance of finances in the implementation of CE – financial motivations, especially for profit-driven entrepreneurs, is a very strong and often emphasized aspect. It is a manifestation of a pragmatic approach and a certain calculation that is ultimately responsible for "to be or not to be" in the market. The connection between the activities carried out within the framework of CE and the specific financial benefits that are expected from a given company cannot be detracted from. There is an appeal to seeing this connection in a natural way, and not in a pejorative way. Investments made in CE, according to respondents, should pay off in the short or long term. At the very least, an entrepreneur should not lose out on CE activities. Since "Being eco is not cheap," many companies are still reluctant to implement a CE measure (of course, this also depends on the scale of such measures - we can talk about micro measures as well as expensive technologies). Actively seek support (and consciously use it) - various forms of funding, loans, and projects are an integral part of a company's implementation of CE policy. This is because often a company, as a private entity, from a financial level, cannot handle CE challenges on its own, and then this may be

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a reason not to pursue it. Recommendations in this aspect, therefore, concern building an efficient, effective and transparent system of subsidizing CE activities for specific companies at each stage of their development, as well as the life cycle of a given product (also an important issue - promotion of a new product, often emphasized by experts).

Among the more detailed recommendations of experts, the following suggestions also emerged:

- Supporting technical education faculties developing the potential to create and implement technologies and solutions in line with CE
- Modifying the content of school programs by introducing issues related to CE.
- Improving the quality of promotional campaigns for residents that will increase commitment to segregate garbage, e.g. by showing what happens to segregated raw materials (what their further path is).
- Introducing a coherent legal system covering all issues related to waste management including implementation of CE (the current one is incoherent, inconsistent, with "holes", based on successive revisions of previous regulations and their different interpretations).
- The new definition of the role of the municipality in the CE implementation process (the municipality should not be responsible for what it has no influence on).
- Introduction of new regulations, e.g. imposing an obligation to locate PSZOK in every municipality (or more of them at dense populations, e.g. in cities), the establishment of a new service along the lines of "environmental police", which has more authority than WIOS.
- The need to change the approach of law enforcement agencies to the issue of crime against the environment (currently too soft) and to increase the possibility of enforcement of penalties charged by the WIOS.
- Increasing the capacity of WIOSI to operate through funding from WFOSiGW
- Introduce a coherent system regulating financial support for the implementation of CE for both businesses, municipalities and residents
- Introducing consistent systemic support for eco-design (increasing the potential of Polish designers in the area of eco-design) by e.g: providing access to free knowledge and IT tools for eco-design or offering professional training for designers
- Requiring manufacturers to reduce the market share of complex packaging in favour of single-component packaging or packaging in which it is possible to separate individual fractions.
- Accelerate work on the SUP Directive currently under consideration - extended producer responsibility.
- Promote and support cooperation and partnerships in the CE sector in the form of voluntary agreements of producers (including, for example, on the issue of ensuring a certain level of share of secondary raw material in selected types of products and materials).
- System support for the creation and operation of initiatives such as Eagle Pond.

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7.4. Recommendations for the efficiency of CSS's implementation

The incentive system to support the implementation of CE can be considered for specific groups of waste:

- Plastics and Rubber,
- Water and Nutrients,
- Food and Feed,
- Wood Packaging.

Incentives can be dedicated and targeted directly to entrepreneurs and other entities operating in industries relevant to a particular waste group, as well as be universal and independent of waste type. Respondents surveyed indicated both types of incentives, saying, however, that very few of them are dedicated, and most are universal ones. An example of such a universal incentive is the NFOSiGW and WFOSiGW system of grants and loans for the implementation of environmental tasks including those aimed at implementing CE. Individuals, entrepreneurs, NGOs, local government and state budgetary units can apply for them, provided that a specific task is included in the priorities set for a given year in a resolution of the Fund's Board. This type of incentive represents communication model No. 5 (a plurality of Senders and Incentives) and is completed by model No. 2 (mass recipient) and model No. 3 (sectoral recipient). This type of incentive, because of universality, applies to many different Senders, and many different recipients, who may also be diverse within a given group, e.g.: business sectors (industries). The scope of impact of such an incentive is wide, but in this particular case, it is a possibility - an option (not a duty) that can be used.

Plastics and Rubber Waste. The main problem with plastic and rubber waste is their multicomponent and the inability to separate the different fractions. The undertaken activities should aim to encourage (mainly entrepreneurs) to reduce the production of such waste as much as possible. According to the experts surveyed, the segregation of polystyrene foam as a separate fraction could also be done. With regard to this type of waste, the incentive is therefore a (planned) deposit system. The deposit system is an example of a mass communication model. The sender is one and here is the Legislator, the incentive is the deposit, and the recipients are many. They are, for example, companies, as well as individual residents. In this case, it is also important to build the right habits and change the thinking about plastic packaging as a valuable element of the whole goods. Return to the deposit system, which had already existed in Poland before 1989, has not only an economic dimension but also a socio-cultural one. In the case of plastic packaging, social incentives to reduce this type of waste and/or its proper storage play a major role. Functioning for example bottle machines, having their own reusable cups/bottles. Shaping the desired behaviour is also done through systematic education of children and young people. Incentives are thus aimed at a mass recipient, there may be present also a lot of senders. Here, therefore, model 5 is intertwined with models 2 and 3. Considering plastic packaging, the Packaging and Packaging Waste Management Law (dated June 13, 2013) imposes an obligation on marketers of such packaging to design and manufacture it in such a way that it can be reused and later recycled (or otherwise reused). In this case, we are dealing with model No. 2, when the Legislator directs an incentive to multiple recipients (entrepreneurs) or sectors. However, it is not a direct incentive, but an indirect type. This is because it results from a statutory obligation and conditionality.

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In order to reduce the amount of plastic and rubber waste, it is important to expand the network of incinerators. Currently, in the Lodz region, there are only three incinerators. This is an activity aimed at energy recovery more favourable than landfilling. It should be mentioned that the building of incineration is regulated by precise laws. However, the presence of incineration as an incentive itself fits the basic model of incentive No. 1, where the sender is the legislator and the recipient is a local government. An analogous situation applies to the next incentive, the inclusion of a clause in the Provincial Waste Management Plan about the need for waste processing facilities and recycling points. Such a provision in the future provides the basis for applying for the financing of the project.

Water and Nutrients. The issue of wastewater is regulated by the Water Law (Law of July 20, 2017) and is currently more developed than the law on plastic Despite the fact that we distinguish three types of wastewater (1. Domestic wastewater, 2. Municipal wastewater, and 3. Industrial wastewater), only municipal wastewater can be reused. Wastewater management is specific due to its physical state, which determines the forms of its discharge and collection. For this reason, among others, state and local government institutions play a major role in the management of this waste. The system of wastewater transportation, which is mass and organizationally demanding, determines the collective forms of work with this resource based primarily on public institutions. Considering wastewater sludge, a form of support for its reuse is a clause in the Waste Law (dated December 14, 2012), which says that wastewater sludge can be used as fertilizer (for agricultural use), as well as the Law on Fertilizers and Fertilization (dated July 10, 2007), which says that the appropriate standards must be met for sludge to be reused. In both of these cases, we are dealing with Model No. 6 (the plurality of incentives), with composing Model 2. In this situation, there is one Sender, which is the Legislator, many incentives and a mass Recipient. The analogy is with regard to sludge composting.

Food and Feed. On the issue of food, an important regulatory role is played by the Law on the Prevention of Food Waste (dated July 19, 2019), which sets out the rules for handling food and the obligations of food sellers to prevent food waste through free donations to NGOs. The law also obliges food sellers to conduct education and information campaigns in the trading unit on rational food management and preventing food waste. In this case, the incentive model applies - one Sender, which is the Legislator, several incentives and several recipients. Thus, model No. 6 (multiplicity of incentives), complements model No. 2. The issue of food waste is a serious social problem with significant social consequences. It's a problem for highly developed countries, and mainly refers to consumers and food sellers. The determinants of this problem are very diverse, with low awareness, gaps in knowledge and a lack of built right attitudes and habits. For this reason, such actions and activities are being set up, such as food-sharing, social refrigerators, and food banks run by various institutions. These incentives are socio-culturally-educationally rooted, so models with a simultaneous multiplicity of Senders, Incentives and Recipients are most effective. A synergistic combination of models is therefore important. One of the incentives for farmers is a four-year NFOSiGW project (2019-2023) titled "Disposal of agricultural films and other waste from agricultural activities". The project allows farmers to obtain grants for this purpose. The beneficiaries of the program are local government and their associations, and the final recipients are holders of agricultural film, netting and twine waste and fertilizer packaging. The applicable incentive model is therefore one with mass characteristics, where there are many different recipients.

Wood Packaging. Post-consumer wood is a valuable raw material that can be effectively reused in the manufacturing process. In Poland, the popularity of recovery of such material is still too low. Thus, it seems that an appropriate incentive system devoted to this waste has not yet been built. Especially since it seems to be the easiest type of waste to reuse. As a rule, wood waste and pallets are suitable and mostly used for repairing the next pallets. As for shavings and offcuts - they are used as

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part of pellet production. The Waste Law allows either loss of waste status or reclassification - from waste to product. Here, simple model No. 1 mainly works one Sender, which is the Legislature, one incentive in the form of a specific provision, and one type of recipient. Wood waste is not a problem, it gets a second life offhand. Their use as a raw material is therefore very common. The waste that results from logging is immediately sold to the local society. Old boards and wood recovered from wooden pallets or furniture are used to produce horse bedding, gardening primer, wood pallet brackets and even new floorboards and furniture. Post-consumer wood products are not qualitatively or visually different from virgin wood products. What is more, they are often even preferred due to the fact that, unlike fresh wood from the forest, they are already dried. The main incentive for the reuse of wood by entrepreneurs is the economic rationality of the enterprise and the possibility of increasing profit, for the reason that the supply of wood from the forests is disproportionate to the needs of the market. In addition, its prices are constantly increasing. The availability of by-products from sawmills, which are used in the production of panels, is also limited. The industry has to compete for sawdust and shavings with the power industry, which buys huge amounts of them to generate biomass energy subsidized as RES. The recovery and reprocessing of wood is therefore not only justified from an ecological point of view but is economically necessary.

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8. Public Circular Procurement scheme dedicated to Circular Systemic Solutions

8.1. Methodology

8.1.1 Methods of research

Regarding the implementation of green public procurement in 2008, the European Union has set a target for green public procurement to accounting for min. 50% of total contracts awarded. In the European Commission's report 'The Uptake of Green Public Procurement in the EU27', prepared in 2012, green public procurement accounted for the largest share of public procurement in four countries: Sweden, Denmark, the Netherlands, and Belgium (the share ranged from 60%-80%). Unfortunately, most Member States do not implement green public procurement at the desired level. In as many as twelve EU countries, the share of green public procurement in 2012 did not even exceed 20%. It is therefore important to intensify efforts to get the public sector more involved in creating CE-friendly markets.

The aim of the conducted research was:

1. Identification of the characteristics of the sustainable public procurement market in the Lodzkie Region in comparison to Polish regions.
2. Preparation of criteria catalogs dedicated to each of the 4 CSS being the subject of the project (wood packing, food, and feed, waste and nutries, plastic and rubber).

A triangulation of research methods was used in this study. The following methods were adopted: **(1) desk research, (2) analysis of statistical data, (3) diagnostic survey, and (4) individual in-depth interviews.**

In identifying the characteristics of the sustainable public procurement market, datasets obtained from the Public Procurement Office were analyzed. The analyses of the sustainable public procurement market in Poland cover the period 2016-2020. In addition, individual in-depth interviews were conducted at the City Hall of Kraków (one of the two cities in Poland with a circular city development strategy) and diagnostic surveys were conducted in all 16 regional government offices in Poland. These studies allowed us to verify 3 research hypotheses:

Hypothesis 1[H1]: Green public procurement is a good basis for supporting the organization of the circular economy in Poland.

Hypothesis 2[H2]: The sustainable public procurement market in Poland is developing insufficiently.

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Hypothesis 3[H3]: Green public procurement is an underdeveloped part of sustainable public procurement.

In order to create a list of criteria for selected four CSSs, European Union documents, strategies and programs were analyzed. In addition, the available strategic documents at the EU level containing good practices or criteria for the application of GPP were analyzed. Using these methods, the identification of sustainable public procurement criteria and the objectives of implementing green public procurement dedicated to strengthening the circular economy were made. The catalog of criteria has been prepared and broken down into:

1. Criteria of green public procurement;
2. Criteria of socially responsible public procurement.

The criteria of the subject of the contract are one of the most frequently used instruments to engage green public procurement (Pro-Akademia, 2019).Then, referring to the standards defining the description of the subject of the contract - the Specification of the Terms of the Contract, three basic criteria selection areas have been selected:

1. Description of the subject of the contract (supplies, services, construction works);
2. Information on the said means of proof (certificates, labels);
3. Other criteria.

The description of the subject of the contract is all the most important information related to the public procurement contained in the Specification of the Terms of the Contract (formerly: the Specification of Essential Terms of the Contract). The presented criteria may be included either in the description of the subject of the contract or may constitute a separate criterion apart from the price criterion. The decision whether an exemplary criterion will be included only in the description of the subject of the contract, or will be treated as a separate criterion beyond the price criterion, which determines the selection of the best offer, rests with the contracting entity. This decision will usually result from the specific nature of the public contract being awarded. Under the Public Procurement Law, Art. 7 point 20. (Journal of Laws 2021), the subject evidence means the means of confirming the compliance of the offered supplies, services, or works with the requirements, features, or criteria specified in the description of the subject of the contract or the description of the tender evaluation criteria, or the requirements related to the execution of the contract.

The last element that appears in the tables is the so-called **other criteria.** This section includes, among others: exemplary criteria that relate to awarding additional points to tenderers who implement a specific action, or criteria that constitute a separate criterion apart from the price criterion taken into account when selecting the best offer. The desc research was carried out on the basis of the most important available documents on the solutions operating in all EU Member States, such as:

1. "Social Issues in Purchasing. "2021, Guide to Integrating Social Issues into Public Procurement. European Commission, 2nd Edition,
2. "Green Purchasing!" Handbook on green public procurement. 2016, 3rd Edition. European Union,
3. "Circular Procurement!", 2017, Best Practice Report. Local Governments for Sustainability, European Secretariat,

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4. "A European Strategy For Plastics in a Circular Economy." 2018, European Commission Report,
5. "Public Procurement Guidance for Practitioners.", 2015, European Commission Report,
6. "Pre-commercial Procurement: Driving innovation to ensure sustainable high-quality public services in Europe.", 2007, Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee, and the Committee of the Regions,
7. "Regional guidebook on circular procurement.", 2021, Regional guidebook on circular procurement - Elverum, Norway,
8. "Regional guidebook on circular procurement.", 2020, Regional guidebook on circular procurement - Portugal,
9. "Collection of statistical information on Green Public Procurement in the EU.", 2010, Report on data collection results. Report on data collection results,
10. "Public procurement for a circular economy.", 2018, Guidance and good practices. European Commission.

The analysis also considered EU guides on the application of GPP for specific product groups (https://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm). Guides have been selected, the subject of which may directly or indirectly concern one of the 4 CSS areas in the Frontsh1p project. In particular, selected criteria from the following reports were taken into account:

- Public Space Maintenance (Brussels, 13.11.2019 SWD(2019) 404 fina),
- Food Catering services and vending machines (Brussels, 27.9.2019 SWD(2019) 366 final),
- Sanitary Tapware (Kaps, Wolf, 2013),
- Waste Water Infrastructure (GPP Criteria for Waste Water Infrastructure, 2013)
- Furniture (Brussels, 27.7.2018 SWD(2017) 283 final/2),
- Water-based Heaters (Quintero, Genty, Vieitez, Wolf, 2014),
- Copying and Graphic Paper. Background Product Report (European Commission, 2008),
- EU GPP criteria for horticultural products and services. (European Commission, 2012),
- Toilets and Urinals (Genty, Kowalska, Wolf, 2013).

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8.1.2. State of the art

Public procurement is a safe tool for testing new solutions, showing good practices, and involving the private and social sectors in new areas of activity, especially those important for the development of CE. Apart from the intervention function, the state should increase social awareness. Undoubtedly, it is a difficult activity, but possible to implement, mainly through social education (various types of social campaigns or educational programs) and public procurement, in particular the so-called socially responsible public procurement.

The significant role of public procurement results in it being treated as a tool that states use to achieve their objectives and integrate their activities. In addition to this, legal regulations related to public procurement result in the correct and efficient spending of public funds. The role of public procurement has gradually changed. One important direction of change is the inclusion and encouragement of environmental and social aspects. Initially, public procurement was used mainly to achieve economic objectives, whereas nowadays it is treated as a tool to achieve not only economic efficiency but also to achieve non-economic objectives. These non-economic objectives of public procurement mainly relate to taking into account the wider interests of different actors, as its use is intended to focus not only on those acting as contracting authorities but also on other actors seemingly unconnected with the procurement procedure.

Legal regulations at the EU level, promoted by the European Commission, led to the formulation of a specific type of public procurement, the so-called **sustainable public procurement**. When talking about sustainable public procurement, it should be understood as "the way of organizing public procurement procedures, which takes into account, where possible, environmental and social aspects, which translates into the nature of the contract, while ensuring the targeted, rational and economical spending of public funds. ". Two types of sustainable public procurement are distinguished. Procurement that takes into account environmental aspects - green public procurement and procurement with social aspects - socially responsible public procurement.

The definition of **green public procurement** was indicated by the European Commission, treating green public procurement as "a process in which public institutions try to obtain goods, services, and works, the impact of which on the environment during their life cycle is lower compared to goods, services, and works of the same purpose as would otherwise have been ordered. ' On the other hand, an explanation of what is meant by **social public procurement** can be found on the website of the Public Procurement Office. This office defines social public procurement as a contract that refers to the stages of public procurement that take into account at least one of the following aspects: promotion of decent work, respect for human and labor rights, support for social inclusion (including people with disabilities, social economy, and SMEs, promotion of equal opportunities and the principle of "accessible and suitable for all", the inclusion of sustainable criteria taking into account fair and ethical trade issues, respecting the treaty principles and public procurement directives. Sustainable public procurement also includes **public procurement for innovation**. type of procurement, as in the case of green public procurement - is defined by the European Commission According to the Commission's guidelines, contracts for innovation are all contracts that have at least one or both of the following properties:

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- *purchase of the process of developing innovative solutions* - which refers to research and development services with at least partial results. In this case, the purchaser buys services that enable the development of a product, service, or process that does not yet exist.
- *purchasing the results of an innovation.* In this case, the purchaser assumes the role of the first user and buys a product, service, or process that has not been on the market for a long time and is therefore innovative.

There is an analogy to sustainable development aspects in sustainable public procurement. The table below shows the similarities (Tab. 8).

Table 8. Convergence of sustainability aspects with types of sustainable procurement.

Sustainable development	**ASPECTS / TYPES**	**Sustainable Public Procurement**
Activities leading to development **take into account pro-social issues**, including eliminating the phenomenon of poverty and hunger, promoting gender equality and social advancement of women, social justice, social order, reducing unemployment, ensuring safety, health protection, and improving the quality of life.	**SOCIAL**	**Socially responsible public procurement** Public procurement, **which take into account pro-social issues**, i.e. promotion of decent work, respect for human rights and labor law, support for social inclusion, social economy and SMEs, promotion of equal opportunities and the principle of "accessible and suitable for all", taking into account the issue of fair and ethical trade, respecting the principles of treaties and directives on public procurement
Activities leading to development **take into account pro-ecological issues**: reducing the amount of waste generated, minimizing the consumption of resources (including non-renewable resources), and reducing the degree of environmental degradation. To achieve the above-mentioned goals, the transition to the model of the so-called **circular economy (circular economy).**	**ENVIRONMENTAL**	**Green public procurement** Public procurement in which **environmental considerations are taken into account** - this will be all contracts during the execution of which, the negative impact on the environment is reduced.
In activities leading to development**, economic issues are taken into account**: striving for production balance, increasing entrepreneurship, reducing or eliminating unsustainable trends in production and consumption, or **increasing innovation**.	**ECONOMIC**	**Public procurement for innovation** Public procurement, which **take into account pro-innovation issues** - these will be all procurement that consists in purchasing the innovation development process or purchasing the result of innovation.

Source: J. Piotrowska, Z. Przygodzki, own compilation.

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When identifying the market and the criteria for applying sustainable public procurement, attention should be paid to the concept of circular procurement. Each circular order is also a green public order. On the other hand, not every green public procurement is a circular procurement. Circular procurement can be defined as the process by which public or private authorities procure works, supplies, or services aimed at contributing to closed loops of energy and materials along the supply chain, minimizing and at best preventing negative environmental impacts and waste generation the entire life cycle. " In simple terms, circular procurement can be considered as all public procurement that is based on the concept of a circular economy and a closed supply and value chain. For the public procurement to appear as a circular procurement, it should be the subject of the procurement:

- products of the highest and at the same time adequate to the needs of quality, which fit into the concept of the circular economy - these will be products that can be regenerated, repaired, improved, or reused (generally products that do not generate waste) and products whose use or use will be stimulated the saving of energy and/or raw materials,
- products that cannot be remanufactured, repaired, improved, or reused, but that can be used as raw materials to produce new products under a specific closed (eco) system.

Green public procurement is regulated at the level of the European Union. The most important, currently applicable directives that regulate issues related to green public procurement are the so-called classic directive - Directive 2014/24 / EU of the European Parliament and of the Council of February 26, 2014, on public procurement and Directive 2014/25 / EU of the European Parliament and of the Council of February 26, 2014 on procurement by entities operating in the water management sectors, energy, transport and postal services repealing Directive 2004/17 / EC. Both of the above-mentioned legal regulations "provide the Member States with various types of instruments for the efficient and effective implementation of the public procurement policy at all stages of the procedure." In Poland, the most important tool for applying green public procurement is the Act of September 11 - Public Procurement Law (Journal of Laws 2021, item 464, as amended). The provisions of the Act in many cases directly indicate how to shape the implementation of green and green conditions. circular public procurement. Basic instructions are indicated in Table 9.

Table 9. Provisions of the Public Procurement Law promote ecological aspects and facilitate the implementation of green and circular public procurement

Article number	Thematic scope	Interpretation of the standard facilitating the implementation of green and circular public procurement
Article 17(1) point 2.	*SECTION I:* General provisions *Chapter II:* Principles of awarding contracts	As stated in the quoted article, the contracting authority shall award the contract in such a way as to ensure that the best effects of the contract, including social, environmental, and economic effects, are achieved, insofar as any of these are attainable in the contract, in relation to the expenditure.
Article 83(1)	*SECTION I:* Procedure for the award of a classic contract with a value equal	Pursuant to paragraph 1 of the article in question, the public contracting authority, prior to commencing the contract award procedure, performs an analysis of needs and requirements, taking into account the type and value of the contract.

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Article 83(3) point 4.	to or exceeding the EU thresholds *Chapter I:* Preparation of the procedure *Subchapter I:* Analysis of the contracting authority's needs, initial market consultations and prior involvement of contractors	The analysis referred to in Art. 83 par. 1 of the Public Procurement Law shall obligatorily indicate the possibilities to take into account social, environmental or innovative aspects of the contract.
Article 96(1) Article 96(2), point 1	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter I:* Preparation of the procedure *Subchapter III:* Determining certain terms of the contract	In the light of Article 96(1), the contracting authority shall be free to specify in the contract notice the contract notice or the contract documents [...] requirements connected with the performance of the contract which may include economic, environmental, social, innovation, employment or the confidentiality of information provided during the performance of the contract. related to innovation, employment or the confidentiality of information provided during the performance of the contract. The text of paragraph 2(1) of the cited Article specifies that the guidelines referred to in Article 96(1) may concern in particular the application of certain environmental management measures.
Article 101(1), point 1.	*SECTION I: Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds* *Chapter I:* Preparation of the procedure *Subchapter IV:* Description of the subject of the contract	In accordance with the content of the quoted article, the contracting authority describes the subject of the contract, taking into account separate provisions, including by specifying performance or functionality requirements, including environmental requirements, provided that the parameters provided are sufficiently precise to enable contractors to determine the subject of the contract, and the contracting authority to award the contract.
Article 102(1), point 1.	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter I*: Preparation of the procedure *Subchapter IV:* Description of the subject of the contract	Under the said article, the contracting authority shall specify in the description of the subject-matter of the works contract the required characteristics of the material, product or service corresponding to the intended use of the contracting authority, which may in particular concern specific levels of environmental performance.
Article 104(1)	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter I:* Preparation of the procedure *Subchapter V:* The evidence in question	According to the Public Procurement Office, a label should be understood as "any document , including a certificate or attestation, which confirms that a construction work, product, service, process or procedure meets the requirements for obtaining the label". According to the wording of Article 104(1), in the case of contracts with specific environmental, social or other characteristics, the contracting authority, in order to confirm the compliance of the works, supplies or services offered with the required characteristics, may, in the description of the subject matter of the contract, in the description of the criteria for evaluation of tenders or in the requirements related to the performance of the contract, require a specific label from the economic operator [...].
Article 109(1), point 2	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter II:* Subject qualification of contractors *Subchapter I:* Grounds for exclusion from the procurement procedure	Under the cited article, the contracting authority may exclude from the procurement procedure an economic operator who has breached obligations in the field of environmental protection, social law or labour law.
Article 116(1)	*SECTION I*: Procedure for the award of a classic contract with a value equal	In the light of the discussed article, with regard to technical or professional capacity, the contracting authority may define the conditions relating to the necessary education, professional

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	to or exceeding the EU thresholds *Chapter II*: Subject qualification of contractors *Subchapter II:* Conditions for participation in the procedure	qualifications, experience, technical potential of the contractor or persons directed by the contractor to perform the contract, enabling the contract to be performed at an appropriate quality level. In particular, the contracting authority may require that economic operators meet the requirements of the relevant quality management standards, including accessibility for disabled people, and environmental management systems or standards, indicated by the contracting authority in the notice. about the order or in the procurement documents.
Article 224(1) Article 224(3), point 7	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter V:* Evaluation of tenders	Pursuant to Article 224(1), if the offered price or cost or their significant components seem abnormally low in relation to the subject matter or raise doubts in the contracting authority as to the possibility of performing the subject matter of the contract in accordance with the requirements specified in the contract documents or resulting from separate regulations, the contracting authority shall demand explanations from the contractor, including submission of evidence as to the calculation of the price or cost or significant components. Such explanations may relate to compliance compliance with environmental regulations.
Article 242(1) Article 242(2), point 3	*SECTION I:* Procedure for the award of a classic contract with a value equal to or exceeding the EU thresholds *Chapter VII:* Selection of the best offer	Under Article 224(1), the most advantageous tender may be selected on the basis of: - quality criteria and price or cost, - price or cost. The legislator also indicates that under the concept of quality criteria may be criteria relating to environmental aspects, including energy efficiency of the subject matter of the contract.

Source: J. Piotrowska, Z. Przygodzki, own compilation based on Journal Of Laws 2021, item 464 as amended

The state of development of sustainable public procurement in Poland is shown in Table 10.

Table 10. Public procurement in Poland in 2020, including green and innovative public procurement and social public procurement.

Green and innovative public procurement	**Information**	Social public procurement
384	**Number of contracting authorities that awarded a contract of a given type**	2 587
1 544	**Number of public procurement contracts**	28 499
12 323 813 756,82 zl (excluding VAT)	**Total value of public procurement**	72 462 672 778,08 zl (excluding VAT)
1%	**Share of public procurement contracts of total public contracts awarded**	21%
7%	**Share of public procurement contracts of total value of public contracts awarded**	40%

Source: J. Piotrowska, Z. Przygodzki based on the report of the President of the Public Procurement Office on the functioning of the public procurement system in 2020

Table 11. The number of awarded sustainable public contracts in regions in Poland in 2016 and in 2020 per 100,000 residents.

A type of sustainable public procurement	**Socially responsible public procurement**		**Green public procurement**		**Public procurement for innovation**	
Region / Years	2016	2020	2016	2020	2016	2020
LOWER SILESIA	9,09	53,47	0,69	3,94	0,03	0,28
KUYAVIA-POMERANIA	8,83	70,76	0,48	2,72	0,00	0,00

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LUBLIN	12,70	59,37	0,75	1,43	0,05	0,10
LUBUSZ	11,70	78,94	0,69	3,77	0,00	0,40
LODZKIE	12,51	59,56	2,58	2,87	0,00	0,16
LESSER POLAND	9,61	74,10	2,69	5,95	0,06	0,18
MASOVIA	30,84	121,03	2,18	5,71	0,04	0,22
OPOLE	13,90	56,92	3,52	7,27	0,00	0,82
SUBCARPATHIA	7,47	46,53	0,56	2,22	0,14	0,00
PODLASKIE	9,44	63,92	0,42	2,13	0,00	0,00
POMERANIA	10,36	65,28	0,48	2,39	0,17	0,13
SILESIA	12,94	81,27	1,65	4,76	0,13	0,11
SWIETOKRZYSKIE	12,29	67,20	0,56	1,96	0,00	0,24
WARMIA-MASURIA	19,22	79,49	0,49	1,62	0,00	0,00
GREATER POLAND	11,66	59,03	0,98	2,83	0,03	0,14
WEST POMERANIA	12,18	67,89	0,64	1,07	0,00	0,00

Source: J. Piotrowska, Z. Przygodzki based on the report of the President of the Public Procurement Office on the functioning of the public procurement system in 2020

Figure 29. The structure of socially responsible public procurement in Poland in 2020 [%]

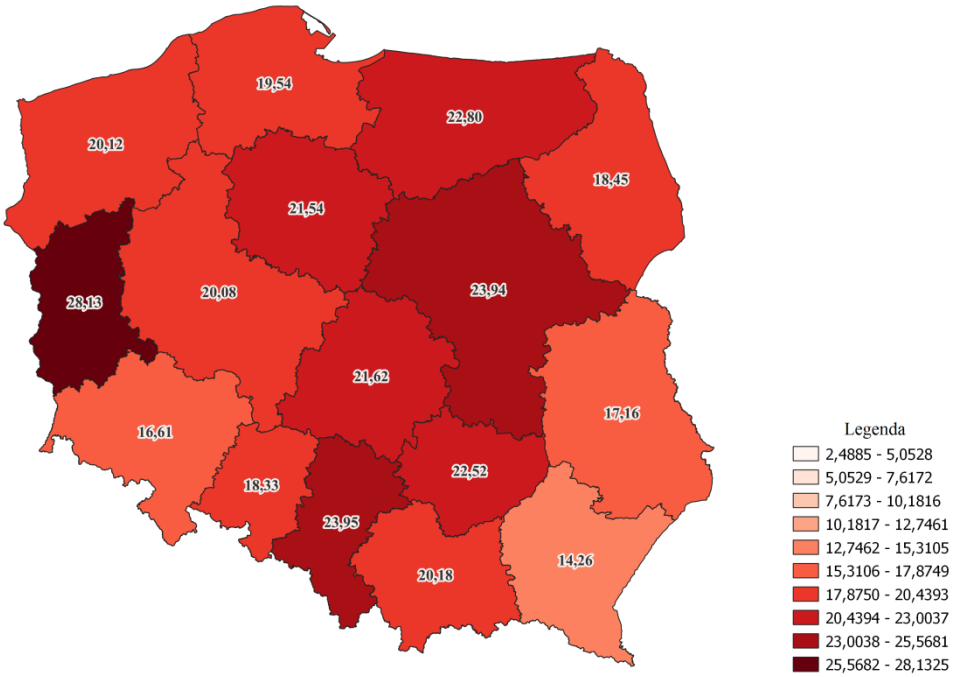

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Figure 30. The structure of green public procurement in Poland in 2020 [%]

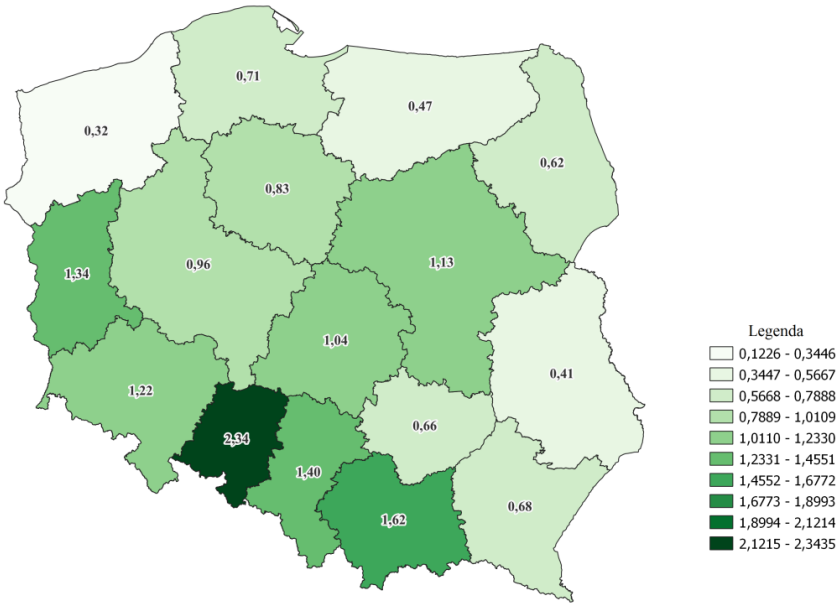

Figure 31. The structure of public procurement for innovation in Poland in 2016 [%]

Source: J. Piotrowska based on data from the Public Procurement Office

In summary, in 2016, nearly 0.5% of all public procurement was green procurement, while the value of awarded green contracts in Poland, in the first year of analysis, accounted for less than 1% of the total value of awarded public procurement. On the other hand, in 2020, one in every 100 public contracts awarded was a green contract, while the value of socially responsible contracts awarded in Poland, in the last year of the analysis, accounted for nearly 6.5% of the total value of public contracts awarded. Verification of research hypotheses:

H1: Green public procurement is a good basis for supporting the organization of the circular economy in Poland. " - the hypothesis has been accepted. In the course of cabinet research, a

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number of solutions enabling the use and implementation of green and circular public procurement in Polish conditions were identified. Legal standards and applied institutions are consistent with the guidelines of the European Commission and similar to those applied in other EU countries.

H2: Sustainable public procurement market in Poland is underdeveloped - hypothesis accepted. Based on the analysis of statistical data, it can be concluded that the sustainable public procurement market in Poland is developing unevenly. It concerns both the development of particular types of sustainable public procurement and the spatial diversification of its implementation. Over the period 2010-2020, socially responsible public procurement is developing best. This is confirmed by the fact that the percentage of socially responsible public procurement implemented in 2020 exceeded in each voivodeship the level of 12% assumed in Poland (in the National Action Plans) for the share of public procurement containing pro-social clauses in the total number of public procurement contracts. In contrast, green public procurement and public procurement for innovation did not reach the level of 20% assumed in the National Action Plans. The differences from the assumptions are significant.

H3: Green public procurement is an underdeveloped part of sustainable public procurement. - the hypothesis has been accepted. The analysis showed that the percentage of green public procurement, treated together with public procurement for innovation, implemented in 2020 did not exceed in any voivodeship the level of 20% assumed in Poland (in the National Action Plans) of public procurement containing pro-social and pro-innovation clauses in the total number of public procurement. In 2020, green and innovative public procurement accounted for approx. 1% of the total number of public contracts awarded in Poland.

In order to improve the effectiveness of GPP use, particular attention should be paid to LCA and DPP. The use of **life cycle assessment (LCA)** in CE allows companies to measure environmental performance, develop and implement innovative strategies and ensure ecological sustainability through eco-design. It is also a method that adds new value to the activities undertaken by public authorities and brings tangible benefits to consumers. (Baran, 2020, p.56). When it comes to formulating public policy, the LCA provides quantitative information that can then be used to make more relevant solutions. (Seidel, 2016)

LCA is becoming a valuable information resource in the formulation of public policy, as it allows and facilitates decision-makers to consider potential unintended environmental consequences that are otherwise unpredictable (Seidel, 2016). Representatives of European public authorities have taken the approach of establishing a policy on green public procurement or incorporating into a different policy area obligations regarding the granting of green public procurement (Buying Green!, 2016). It is important to implement harmonized sets of indicators, to implement green public procurement. These criteria should be based on LCA data and environmental labels and the evidence behind these labels. (Buying Green!, 2016). The idea is also to make consumer products longer-lasting as well as easier to repair and recycle. Therefore, the **digital product passport (DPP)** is a concept of a political instrument, as this tool aims to contribute to the development of the CE. (Adisorn et.al., 2021, p.14). DPP allows tracking of where the raw materials come from. They allow identifying the features of products and their production methods. Digital product passports contribute to the efficient and effective flow of information in the supply chain.

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8.2. Results

8.2.1. Public Circular Procurement scheme to be used for the CSS1 planning

Table 12. Award criteria dedicated to circular system solutions in the area of wood packaging products

Circular Systemic Solution: wood packaging [CSS1].			
Areas		Green public procurement criteria	Criteria for socially responsible public procurement
Description of the subject matter of the contract	Supplies	100% recycled fiber required for office paper. The requirement to reduce deliveries by 85% (from daily deliveries to once or twice a month). Incorporating ecological products into the product range and delivering once a week with vehicles that meet the criteria for sustainable urban transport. Requirement to provide a sample (description or photo) of products or materials. The need for 75% of the materials used in the production of bags to be recycled or biodegradable. Packaging that cannot be reused must be easily separated into the different types of materials. Whenever possible, monomaterials or recyclable materials should be used. The requirement to deliver products in reusable transport packaging. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. Production requirement from recovered paper fibers. If ECF / TCF paper based on virgin fibers is used, it is necessary to determine if the virgin wood fibers for pulp production come from sustainably managed forests. Require the use of timber from legal sources and sustainably managed forests. Need to purchase paper based on post-consumer recycled fibers (recycled paper), or based on legally and / or sustainably obtained virgin fibers. Requirement to purchase paper produced using processes characterized by low energy consumption. The need to purchase at least 75% recycled fiber paper.	Need to guarantee that all delivered products are manufactured in accordance with the UN Convention on the Rights of the Child and ILO Convention 138 on Minimum Age for Admission to Employment, and other ILO core conventions. In the case of an order for the supply of means of transport or related services, the need for the machines used to be adapted to the elderly and people with disabilities. In ordering ICT equipment to be delivered to the office, the requirement is to submit specific equipment configured for use by people with disabilities.

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		As a requirement, it was produced at least without elemental chlorine or other chlorine compounds. Necessity to provide a paper sample for quality testing. Require that the paper be made of 100% recycled fibers with at least 65% recycled fibers from post-consumer waste. Purchase of office paper based on virgin fibers from legal or sustainable sources. Need to supply paper with a whiteness level of less than 90. The need to provide paper made from virgin wood fibers for the production of wood pulp that has been verified as managed in a way that allows the implementation of rules and measures to ensure sustainable forest management. Setting minimum requirements for product durability, spare parts and guarantees. The need to reduce the levels of hazardous substances in electronic and electrical devices. The requirement that paper products (e.g. copy paper) be made of 100% recycled paper fibers. The requirement that the delivered furniture should be easy to disassemble, repair and recycle.	
	Services	In the case of supplies or services, the need to use ...% recycled or biodegradable packaging products recycled or biodegradable packaging. Requirement to produce from recovered paper fibres. In the case of the use of virgin fibre-based ECF/TCF paper, the need to specify whether the virgin wood fibres for the pulp are from from sustainably managed forests. The requirement to use wood from legal sources and sustainably managed forests. A requirement to procure paper based on post-consumer recycled fibre, (recycled paper), or paper based on legally and/or sustainably sourced virgin fibre. The requirement to purchase paper produced using processes with low energy consumption. The requirement to purchase paper made from at least 75% recycled fibre. The requirement, at a minimum, to have been produced without the use of elemental chlorine or other chlorine compounds. The equirement to provide a sample of the paper for quality testing. The equirement that the paper is made from 100% recycled fibre, containing at least 65% recycled fibre from post-consumer waste.	In the contract for the implementation of state services - the need for the contractor to reach each of the target groups specified in the specification and for the implementation of special measures contained in its offer in order to reach older users, people suffering from social isolation and without access to the Internet. The requirement of key competences and application of key environmental management measures and practices to service providers. The requirement to ensure adequate and frequent training of workers employed by service providers.

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		The requirement to purchase office paper based on virgin fibre from legal or sustainable sources. Preferring furniture rental to furniture purchase.	
	Construction work	The need to use a life-cycle costing model that takes into account the purchase price, fuel consumption and maintenance and operating costs. In the case of demolition, the need to identify the management of hazardous materials. The need to identify the costs associated with the disposal of hazardous materials. The need to identify the savings achieved through the use of recycled waste materials. For construction - need to identify environmental impacts. A requirement that at least ...% of the materials used during construction/activity should be a reused or recycled product. A requirement to submit details of any refurbishment activities to be carried out.	Require contractors to support training opportunities for unemployed people in carrying out public works. Require the contractor to hire and train unemployed or disadvantaged people. The contractor must be responsible for the recruitment, training and employment in the performance of this contract of at least X [number specified in the tender] persons who match at least one specific category of disadvantaged workers.
	All contract items	The need to conduct comprehensive research on the needs and expectations of customers. Require the use of sustainable, high-quality products at lower cost and facilitate access to local producers. Require supply chain details for specific product models and production sites used under the contract. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. Reserve the obligation to hold debriefing meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal was inadequate. The need to identify and confirm technical capacity to monitor working practices across the supply chain, including management systems and partnerships with other organisations. The requirement to include relevant experts on the bid evaluation panel. A collaborative procurement approach. Competitive dialogue as a form of procurement. Definition of technical standards and contractual clauses, including a surety of compliance on environmental issues relating to waste management and component and noise management.	Requirement to conduct public consultations with various stakeholders of a given activity. The necessity for the contractor performing the orders to appear as a social entrepreneur (dealing, for example, with integration in the labor market). The need to conduct comprehensive research on the needs and expectations of customers. Requirement of dialogue sessions with several third sector suppliers. Requirement of employing disabled people. The need to define guidelines for the accessibility of internet content, which include, inter alia, guidelines for blindness and visual impairment, deafness and hearing loss, learning disabilities, cognitive deficits, reduced mobility, speech disorders, photosensitivity, and combinations of these difficulties. Require supply chain details for specific product models and production sites used under the contract. The need for bidders to have a system to ensure that the production process of the purchased goods does not violate labor rights protected by the conventions of the International Labor Organization.

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		Reservation of the need for stakeholder consultation. Requiring minimum requirements for energy and water efficiency. Requirement of a criterion: sustainability, including a 'performance ladder' of work processes in terms of CO2 emissions and a life-cycle assessment of the products used. The need for eco-friendly cleaning methods, reduced packaging, product environmental performance (percentage of products complying with the with ISO Type I labels or equivalent) and the quality of environmental training programmes. The need to implement an informal environmental management system in three steps: conduct an initial environmental review of the service, launch an environmental programme, ensure that steps are taken to monitor the programme. Obligation to submit (every six months) data on the volumes used. The requirement for transport vehicles to meet the latest emissions standards and the need not to generate CO2 emissions in excess of maximum levels. Requirement of determining the origin of wood. The need to use at least 50% of wood that comes from certified sources. The need to determine whether the certified or non-certified wood is used. The requirement to limit the use of hazardous substances in order to select the best available wood treatment technique. Requirement to limit VOC and formaldehyde emissions (e.g. ≤ ½ E1). When determining the service life - the requirement to indicate the frequency with which the product or its part must be replaced. Defining minimum requirements for quality and durability standards. Minimum warranty requirement and spare parts availability. Determining the criteria for the use of electricity at the stage of operation. Defining criteria for fuel consumption. Require the use of low-polluting or harmless materials and products in order to improve the recyclability of the products themselves and their packaging. Requirement for products to be disassembled for recycling. Purchase of materials with recycled fibers or recycled paper etc.	Require suppliers to use supply chain traceability systems, a risk assessment process and a supplier code of conduct. Requirement to provide the concept of social criteria, including measures to ensure that their suppliers and sub-suppliers comply with the eight core ILO conventions. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. The necessity for the execution of the contract to create opportunities to achieve specific social effects and ethical. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. Require that tenderers employ disadvantaged workers for all their activities (and not just for the performance of the contract in question). Require that tenderers have an overall corporate social responsibility policy, rather than specific requirements on how to perform the contract. Specification that tenderers employ at least…% of disabled or disadvantaged workers. Requirement for the organization or its teams to have specific experience and specific expertise in dealing with societal issues relevant to the contract in question. Number and quality of apprenticeship / training opportunities created by contract execution. Tenderers must detail their attitude towards recruitment and training, provide a trial job specification for apprenticeships and describe the support structure to be implemented. In the context of gender equality, it is the contractor's responsibility to ensure that all direct supervisors of contracting staff complete training in aspects of gender equality in recruitment and employment, including pregnancy and maternity;

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		Defining the minimum content of recycled materials in packaging. Requirement of determining the reusability of the product. The need to indicate ways to recycle the product or its parts. Requirement to indicate information on the possible presence of harmful chemicals. Indication of product design and labeling requirements. Requirement to identify the recyclability of plastics. The need to determine the methods of sorting and disassembling products. Requirement to determine the chemical composition of plastics. The need to indicate potential contamination arising during the use of products. Requirement to replace single-use plastic products with reusable products or products made of biodegradable plastics. Require that wood and wood-based materials are derived from legally harvested wood and that at least 70% of these materials are derived from recycled or sustainable wood. Requirement to supply single-use products with low environmental impact. Require the use of compostable rubbish bags awarded for bio-waste. Requirement of a declaration of the use of only wood from legal sources. Necessity for the furniture product to meet the requirements set out in the latest versions of the following relevant EU standards, which may relate to durability, dimensional requirements, safety and strength of the product. In this case, an appropriate declaration is required. Need to provide a manual that includes an exploded view for the product, showing the parts that can be removed and replaced, and the necessary tools. Need to provide a warranty for ... years by providing a written statement of warranty that covers repair or replacement and concludes a service contract with pick-up and return or on-site repair. The need to present or include product life cycle costs in the offer. Requirement to provide detailed information on furniture take-back arrangements as well as planned routes for reuse and recycling. These include detailed information on all parties involved in reusing and recycling furniture.	menopause; sexual harassment; family-related leave such as parental leave and work-life balance etc. With regard to the minimum wage, the contractor and all subcontractors operating within the jurisdiction in which the contract is performed will comply with the specified minimum wage rates (applicable law or collective agreement) and will keep records of hours worked and wages paid. Require that all mandatory grounds for exclusion and any optional grounds that apply to the contract be adhered to on an ongoing basis during the performance of the contract, with regular updating of declarations by the responsible contractors and subcontractors.

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		Need to authorize the contracting authority to carry out random checks on compliance with technical specifications of all furniture products used under the contract. Local management and production of renewable energy systems based on biomass	
Information on the evidence in question		Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. The requirement to have certificates in the field of environmental management. Requirement for tenderers to have third party labels or certificates for a certain proportion (%) or all of their products. Labels or third party certification required. Necessity to submit data identifying the parts of the supply chain and the greatest potential for reducing CO2 emissions. Requirement for a company with an environmental management system to be certified by a third party. The need to submit an eco-label certificate. Requirement to submit a certificate of conformity or quality attestations. The need to use products that have been awarded the EU Ecolabel or other label. Necessity that meat and dairy products (except organic) are produced in accordance with the requirements of the animal welfare certification system. Requirement that products…. produced and marketed in accordance with the requirements of the Fair and Ethical Trade Certification Scheme. Requirement to provide a warranty covering the repair or replacement of the product of at least… years. Necessity to submit a list of recently completed comparable projects (the number and duration of projects should be indicated by the contracting authority), certificates on correct implementation and information on the qualifications and experience of employees. As a rule, the requirements for the above-mentioned projects are very detailed - the need to identify at least ... projects of similar complexity, each of which should cost at least ... million euro and be implemented within the last ... years. Need to endorse the European Union Ecolabel or other equivalent labels. Need to provide a warranty for ... years by providing a written statement of warranty that covers repair or replacement and concludes a	Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. Requirement for contractors applying for the contract to submit certificates or documents attesting to the implementation of previous projects in an inclusive manner. Requirement to provide proof of the successful performance of previous contracts with similar social requirements.

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	service contract with pick-up and return or on-site repair. Requirement to provide a list of comparable projects carried out, a certificate of satisfactory implementation and information on the qualifications and experience of the staff. The need to submit a document certifying the European Union Ecolabel or other relevant ecolabel.	
Other criteria	Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. Tenderers will receive up to 10% of the available points for including at least one Fairtrade International certified product or an equivalent label. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified by Fairtrade International, World Fairtrade Organization or an equivalent certification system.	Tenderers will earn up to 15% of the points available, based on the quantity and quality of the employment opportunities that will be available to disadvantaged workers. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified by Fairtrade International, World Fairtrade Organization or an equivalent certification system. Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. In the case of third party certification of the ethical sources of the products supplied under the contract, points are awarded based on the percentage of the products certified with the Fairtrade mark or having an equivalent certification. Additional points can be awarded for implementing specific measures aimed at combating discrimination and promoting gender equality (e.g. staff training, work-life balance, flexible work system, etc.). In the context of ethical trade, for catering - catering - a requirement that delivered food and drink with a value of at least 5% of the annual contract price will be Fairtrade certified or equivalent.

Source: J. Piotrowska, Z. Przygodzki, own compilation.

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8.2.2. Public Circular Procurement scheme to be used for the CSS2 planning

Table 13. Award criteria for circular system solutions in the area of food and feed products

Circular Systemic Solution: food and feed [CSS2].			
Areas		Green public procurement criteria	Criteria for socially responsible public procurement
Description of the subject matter of the contract	Supplies	The need for ecological supplies, including the supply of locally produced food. Requirement for the percentage of organic food to be delivered and training requirements for kitchen staff. The requirement to reduce deliveries by 85% (from daily deliveries to once or twice a month). Incorporating ecological products into the product range and delivering once a week with vehicles that meet the criteria for sustainable urban transport. Requirement to provide a sample (description or photo) of products or materials. Defining the minimum percentage of the food that must be organically produced. Defining the minimum percentage of seasonal fruit and vegetables or awarding extra points for the use of seasonal fruit and vegetables. Introducing contractual clauses regarding the minimization of food waste and waste in the form of food packaging. The need for 75% of the materials used in the production of bags to be recycled or biodegradable. Packaging that cannot be reused must be easily separated into the different types of materials. Whenever possible, monomaterials or recyclable materials should be used. The requirement to deliver products in reusable transport packaging. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. The need for food bioproduction. Requirement to use seasonal fruit, vegetables and fish. The requirement to use eco-labeled products. Requirement to present the detailed composition of the product, including determination of the origin of organic matter and submission of a declaration of compliance with the requirements specified by the contracting authority.	Need to ensure that all products supplied are manufactured in accordance with the UN Convention on the Rights of the Child and ILO Convention 138 on Minimum Age for Admission to Employment, and other ILO core conventions. In the case of an order for the supply of means of transport or related services, the need for the machines used to be adapted to the elderly and people with disabilities. In ordering ICT equipment to be delivered to the office, the requirement is to submit specific equipment configured for use by people with disabilities.

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		The requirement that ....% of the delivered food and drink products must be produced in accordance with Regulation (EU) 2018/848. The need to provide data (name and quantity) on the food and drink products to be supplied under the contract, with particular indication of the products that comply with the requirements for organic sources. Requirement that at least…. % of purchases of fish and fish products were obtained from stocks at a safe biological level, taking into account environmental impacts, including overfishing or depletion of stocks, biodiversity and responsible and sustainable use of resources. The need to submit a declaration of delivering fish and fish products that meet the above-described requirements. Require to provide a description of how compliance with these requirements will be ensured as part of the contract performance (e.g. by identifying suppliers for specific products). The requirement that in…. % of aquaculture food purchases have been produced in line with the requirements of the sustainability certification scheme. The need to submit a declaration certifying the method of obtaining aquaculture products. The requirement to provide a description of the method of verification of compliance as part of the contract, e.g. by identifying the suppliers of individual products. Requirement to supply eggs in shell from conventional agriculture, marked with the code "1" or "2" (in line with Regulation (EC) No 589/2008 or its amendments). The requirement to provide a description of the method of verification of compliance as part of the contract, e.g. by identifying the suppliers of individual products. Need to purchase or deliver at least…% of units or units of packaged food products containing vegetable oils have been produced from crops that meet environmental criteria for soil, biodiversity, land use change and organic carbon stocks by complying with the certification scheme. Requirement to provide a declaration confirming the above-mentioned activities. Require that at least…% of vegetable oil purchased as a crude ingredient is produced from crops that meet environmental criteria for soil, biodiversity, land-use change and organic carbon stocks by complying with a certification scheme. Requirement to provide a declaration confirming the above-mentioned activities. The need to keep a record of food redistribution. Setting minimum requirements for product durability, spare parts and guarantees.	

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		The need to reduce the levels of hazardous substances in electronic and electrical devices. Biodegradable, non-bioaccumulative lubricants or regenerated oils must be used in machinery. Requirement to use batteries with a very low heavy metal content. Requirement to use or purchase zero-emission machinery. Requirement to provide a copy of the type approval certificate of the machine drive unit.	
	Services	Requirement for the percentage of organic food to be delivered and training requirements for kitchen staff. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. The need for food bioproduction. Requirement to use seasonal fruit, vegetables and fish. The requirement to use eco-labeled products. Requirement to present the detailed composition of the product, including determination of the origin of organic matter and submission of a declaration of compliance with the requirements specified by the contracting authority. The requirement that ....% of the delivered food and drink products must be produced in accordance with Regulation (EU) 2018/848. The need to provide data (name and quantity) on the food and drink products to be supplied under the contract, with particular indication of the products that comply with the requirements for organic sources. Requirement that at least…. % of purchases of fish and fish products were obtained from stocks at a safe biological level, taking into account environmental impacts, including overfishing or depletion of stocks, biodiversity and responsible and sustainable use of resources. The need to submit a declaration of delivering fish and fish products that meet the above-described requirements. Require to provide a description of how compliance with these requirements will be ensured as part of the contract performance (e.g. by identifying suppliers for specific products). The requirement that in…. % of aquaculture food purchases have been produced in line with the requirements of the sustainability certification scheme. The need to submit a declaration certifying the method of obtaining aquaculture products. The requirement to provide a description of the method of verification of compliance as part of the	In the contract for the implementation of state services - the need for the contractor to reach each of the target groups specified in the specification and for the implementation of special measures contained in its offer in order to reach older users, people suffering from social isolation and without access to the Internet. Requirement to ensure adequate and frequent training of workers employed by service providers.

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		contract, e.g. by identifying the suppliers of individual products. Requirement to supply eggs in shell from conventional agriculture, marked with the code "1" or "2" (in line with Regulation (EC) No 589/2008 or its amendments). The requirement to provide a description of the method of verification of compliance as part of the contract, e.g. by identifying the suppliers of individual products. Need to purchase or deliver at least…% of units or units of packaged food products containing vegetable oils have been produced from crops that meet environmental criteria for soil, biodiversity, land use change and organic carbon stocks by complying with the certification scheme. Requirement to provide a declaration confirming the above-mentioned activities. Require that at least…% of vegetable oil purchased as a crude ingredient is produced from crops that meet environmental criteria for soil, biodiversity, land-use change and organic carbon stocks by complying with a certification scheme. Requirement to provide a declaration confirming the above-mentioned activities. Requirement that… days a week, a vegetarian or plant-based menu should be offered. Requirement that the contractor of the contract offers…. vegetarian or plant-based meals proposed daily or .. days a week. The necessity for the "special of the day" to be a vegetarian or plant-based dish. The necessity for the offered dishes to include… grams of plant-derived proteins or legume seeds per week / day. Requirement to supplement…% of meat dishes with beans, grains or vegetables. The need to establish a more accurate inventory inventory and ordering system to prevent over-ordering and the deterioration of inventory. The requirement to develop an inventory of food waste. The need to carry out continuous or periodic measurements of the amount of food waste. The requirement to periodically check the expiry date of the used food or drink products. Necessity to use food near expiry date (flexible meal planning). Require long-term analysis of meals sold to match food orders and analysis of the use of food or food scraps. The need to submit or develop a strategy against overproduction of meals. A requirement for the contractor to use or select packaging that minimizes the generation of food waste. Requirement for the contractor to conduct an advertising campaign aimed at sensitizing people to the phenomenon of food waste. The need to implement a system aimed at providing information on food portions and the quality of prepared meals. The requirement that the ordered products be delivered in bulk, with a long shelf life (if possible). Requirement for products to be delivered in recyclable packaging.	

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		Necessity to submit a description of the stream category waste to be sorted and the procedures for their disposal. Requirement to submit a list of single-use or reusable items that will be used in the performance of the contract, indicating in particular which of them are single-use items. Requirement that single-use products used or manufactured by the contractor be recyclable. Necessity for products used for hand washing, dishwashing and cleaning to comply with the EU Ecolabel requirements for a specific product or substitute. A requirement that paper towels in rolls and kitchen paper comply with the EU Ecolabel requirements for a specific product or substitute. In the case of food supplies, the need to implement a reduction plan to reduce greenhouse gas emissions and air pollutants from vehicles used in the provision of services. Requirement to submit a technical sheet of vehicles that will be used for the provision of services. Requirement that cleaning agents and hand soaps are dispensed in the correct quantity by an automatic dispenser or a dosing pump. The need to keep a record of food redistribution. The need to compost on site, on the premises of the company, to utilize all organic waste generated in this area, including organic wood waste.	
	Construction work	Necessity to use a life cycle costing model that takes into account the purchase price, fuel consumption, and maintenance and operating costs. In the case of demolition - the need to determine how to manage hazardous materials. Requirement to indicate the costs related to the disposal of hazardous materials. The need to determine the savings obtained through the use of recycled waste materials. During construction - the need to determine the impact on the environment. A requirement that at least…% of the materials used in construction / operation must be reused or recycled. Requirement to provide details of any renovation measures that need to be carried out.	Require contractors to support training opportunities for unemployed people in carrying out public works. Require the contractor to hire and train unemployed or disadvantaged people. The contractor must be responsible for the recruitment, training and employment in the performance of this contract of at least X [number specified in the tender] persons who match at least one specific category of disadvantaged workers.
	All contract items	The need to conduct comprehensive research on the needs and expectations of customers. Require the use of sustainable, high-quality products at lower cost and facilitate access to local producers. Require supply chain details for specific product models and production sites used under the contract. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements.	Requirement to conduct public consultations with the various stakeholders in the activity. The necessity for the contractor performing the orders to appear as a social entrepreneur (dealing, for example, with integration in the labor market).

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		Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. The need to identify and validate the technical capacity to monitor work practices throughout the supply chain, including management systems and partnerships with other organizations. Requirement to include the offers of relevant experts in the evaluation panel. Joint procurement approach. Competitive dialogue as a form of awarding the contract. Defining technical standards and contractual clauses, including a guarantee of compliance in environmental issues related to waste management and management of components and noise. Reservation of the need for consultation with interested parties. The requirement to establish minimum requirements for energy and water use efficiency. Criterion requirement: sustainability, including CO2 'performance ladder' of work processes and life cycle assessment of products used. The need to use environmentally friendly cleaning methods, reduce the number of packaging, the environmental performance of the product (percentage of products complying with ISO Type I labels or equivalent) and the quality of environmental training programs. The need to implement an informal environmental management system in three steps: conduct an initial environmental review of the service, start the environmental program, make sure that steps are taken to monitor the program. Obligation to submit (every six months) data on the quantities of products used. The requirement for transport vehicles to meet the latest pollution emission standards and the need not to generate CO2 emissions in an amount exceeding the maximum levels. When determining the service life - the requirement to indicate the frequency with which the product or its part must be replaced. Defining minimum requirements for quality and durability standards. Minimum warranty requirement and spare parts availability.	The need to conduct comprehensive research on the needs and expectations of customers. Requirement of dialogue sessions with several third sector suppliers. Requirement of employing disabled people. The need to define guidelines for the accessibility of internet content, which include, inter alia, guidelines for blindness and visual impairment, deafness and hearing loss, learning disabilities, cognitive deficits, reduced mobility, speech disorders, photosensitivity, and combinations of these difficulties. Require supply chain details for specific product models and production sites used under the contract. The need for bidders to have a system to ensure that the production process of the purchased goods does not violate labor rights protected by the conventions of the International Labor Organization. Require suppliers to use supply chain traceability systems, a risk assessment process and a supplier code of conduct. Requirement to provide the concept of social criteria, including measures to ensure that their suppliers and sub-suppliers comply with the eight core ILO conventions. Requirement to submit a monitoring plan to

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		Determining the criteria for the use of electricity at the stage of operation. Defining criteria for fuel consumption. Require the use of low-polluting or harmless materials and products in order to improve the recyclability of the products themselves and their packaging. Requirement for products to be disassembled for recycling. Purchase of materials with recycled fibers or recycled paper etc. Defining the minimum content of recycled materials in packaging. Requirement of determining the reusability of the product. The need to indicate ways to recycle the product or its parts. Requirement to indicate information on the possible presence of harmful chemicals. Indication of product design and labeling requirements. Requirement to identify the recyclability of plastics. The need to determine the methods of sorting and disassembling products. Requirement to determine the chemical composition of plastics. The need to indicate potential contamination arising during the use of products. Requirement to replace single-use plastic products with reusable products or products made of biodegradable plastics. Requirement to supply single-use products with low environmental impact. Require the use of compostable rubbish bags awarded for bio-waste. Requirement to use gardening machines powered by unleaded gasoline with a benzene content <1.0% by volume, alkylate gasoline, diesel fuel class A or motor fuel based on biofuels.	ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. The necessity for the execution of the contract to create opportunities to achieve specific social and ethical effects. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. Require that tenderers employ disadvantaged workers for all their activities (and not just for the performance of the contract in question). Require that tenderers have an overall corporate social responsibility policy, rather than specific requirements on how to perform the contract. Specification that tenderers employ at least…% of disabled or disadvantaged workers. Requirement for the organization or its teams to have specific experience and specific expertise in dealing with societal issues relevant to the contract in question. Number and quality of apprenticeship / training opportunities created by contract

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			execution. Tenderers must detail their attitude towards recruitment and training, provide a trial job specification for apprenticeships and describe the support structure to be implemented. In the context of gender equality, it is the contractor's responsibility to ensure that all direct supervisors of contracting staff complete training in aspects of gender equality in recruitment and employment, including pregnancy and maternity; menopause; sexual harassment; family-related leave such as parental leave and work-life balance etc. With regard to the minimum wage, the contractor and all subcontractors operating within the jurisdiction in which the contract is performed will comply with the specified minimum wage rates (applicable law or collective agreement) and will keep records of hours worked and wages paid. Require that all mandatory grounds for exclusion and any optional grounds that apply to the contract be adhered to on an ongoing basis during the performance of the contract, with regular updating of declarations by the responsible contractors and subcontractors.
Information on the evidence in question		Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. The requirement to have certificates in the field of environmental management.	Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector.

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	Requirement for tenderers to have third party labels or certificates for a certain proportion (%) or all of their products. Labels or third party certification required. Necessity to submit data identifying the parts of the supply chain and the greatest potential for reducing CO2 emissions. Requirement for a company with an environmental management system to be certified by a third party. The need to submit an eco-label certificate. Requirement to submit a certificate of conformity or quality attestations. The need to use products that have been awarded the EU Ecolabel or other label. Necessity that meat and dairy products (except organic) are produced in accordance with the requirements of the animal welfare certification system. Requirement that products…. produced and marketed in accordance with the requirements of the Fair and Ethical Trade Certification Scheme. Requirement to provide a warranty covering the repair or replacement of the product of at least… years. Necessity to submit a list of recently completed comparable projects (the number and duration of projects should be indicated by the contracting authority), certificates on correct implementation and information on the qualifications and experience of employees. As a rule, the requirements for the above-mentioned projects are very detailed - the need to identify at least ... projects of similar complexity, each of which should cost at least ... million euro and be implemented within the last ... years. Need to endorse the European Union Ecolabel or other equivalent labels. Need to provide a warranty for ... years by providing a written statement of warranty that covers repair or replacement and concludes a service contract with pick-up and return or on-site repair. Requirement to provide a list of comparable projects carried out, a certificate of satisfactory implementation and information on the qualifications and experience of the staff. The need to submit a document certifying the European Union Ecolabel or other relevant ecolabel.	Requirement for contractors applying for the contract to submit certificates or documents attesting to the implementation of previous projects in an inclusive manner. Requirement to provide proof of the successful performance of previous contracts with similar social requirements.
Other criteria	Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. Tenderers will receive up to 10% of the available points for including at least one Fairtrade International certified product or an equivalent label.	Tenderers will earn up to 15% of the points available, based on the quantity and quality of the employment opportunities that will be available to disadvantaged workers.

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	5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified under Fairtrade International, World Fairtrade Organization or an equivalent certification system.	5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified by Fairtrade International, World Fairtrade Organization or an equivalent certification system. Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. In the case of third party certification of the ethical sources of the products supplied under the contract, points are awarded based on the percentage of the products certified with the Fairtrade mark or having an equivalent certification. Additional points can be awarded for implementing specific measures aimed at combating discrimination and promoting gender equality (e.g. staff training, work-life balance, flexible work system, etc.). In the context of ethical trade, for catering - catering - a requirement that delivered food and drink with a value of at least 5% of the annual contract price will be Fairtrade certified or equivalent.

Source: J. Piotrowska, Z. Przygodzki, own compilation.

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8.2.3. Public Circular Procurement scheme to be used for the CSS3 planning

Table 14. Award criteria for circular system solutions in the area of products related to wastewater and nutrients.

Circular Systemic Solution: water and nutrients [CSS3]			
Areas		**Criteria of green public procurement**	**Criteria of socially responsible public procurement**
Description of the subject matter of the contract	Supplies	The requirement to reduce deliveries by 85% (from daily deliveries to once or twice a month). Requirement to provide a sample (description or photo) of products or materials. The need for 75% of the materials used in the production of bags to be recycled or biodegradable. Packaging that cannot be reused must be easily separated into the different types of materials. Whenever possible, monomaterials or recyclable materials should be used. The requirement to deliver products in reusable transport packaging. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. The need to reduce packaging and waste, for example by replacing bottled water with tap water and choosing reusable and refillable packaging when packaging cannot be dispensed with. Non-potable water requirement, and the installation and use of efficient irrigation systems. Requirement to use automatic irrigation systems that allow detailed parameterization allowing to: establish different irrigation zones, adjust the amount of water dispensed depending on the zone, program irrigation periods according to the zones, measure the level of soil moisture and automatically block irrigation according to the zones when the soil moisture level it is high enough (as defined by the contracting authority), e.g. after rain. Necessity to use sweepers equipped with a water recirculation system. Requirement to submit a technical datasheet for the recirculation system. Requirement to identify installations in a waste water treatment plant that do not use potable water for cleaning. Water-saving urinal equipment purchase required for new and refurbished buildings. Setting minimum requirements for product durability, spare parts and guarantees.	The need to ensure that all products supplied are manufactured in accordance with the UN Convention on the Rights of the Child and the ILO Minimum Age Convention No. 138, as well as other ILO core conventions. In the procurement of means of transport or related services, the need for the machines used to be adapted to the elderly and people with disabilities. In the procurement of ICT equipment for the office, the requirement of an obligation to present specific equipment configured for use by persons with disabilities.

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		The need to reduce the levels of hazardous substances in electronic and electrical devices.	
	Services	Requirement to use a substance for de-icing city streets: calcium-magnesium acetate (CMA) as a substance that does not increase the sodium level in drinking water. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. The need to reduce packaging and waste, for example by replacing bottled water with tap water and choosing reusable and refillable packaging when packaging cannot be dispensed with. The need to document information on the amount and method of neutralizing sewage and waste generated in the event of graffiti removal. Non-potable water requirement, and the installation and use of efficient irrigation systems. Requirement to use automatic irrigation systems that allow detailed parameterization allowing to: establish different irrigation zones, adjust the amount of water dispensed depending on the zone, program irrigation periods according to the zones, measure the level of soil moisture and automatically block irrigation according to the zones when the soil moisture level it is high enough (as defined by the contracting authority), e.g. after rain. In the case of irrigation services - the need to supply water directly to the root zone, if possible. Necessity to use equipped sweepers into a water recirculation system. Requirement to submit a technical datasheet for the recirculation system. Requirement to indicate the maximum available flow rates of water to the wash basin / sink, regardless of the water pressure, which at the same time do not exceed the standards indicated in the discussed document. Requirement to submit test results or the manufacturer's technical documentation or other appropriate evidence demonstrating that these requirements are met. The necessity to indicate the lowest maximum available water intensity in the sanitary fittings, regardless of the water pressure, which cannot be lower than the values indicated in the discussed document. The need to submit test results or the manufacturer's technical documentation or other appropriate evidence demonstrating that these requirements are met.	In a contract for the delivery of state services - the need for the contractor to reach each of the target groups identified in the specifications and for the implementation of the specific measures included in its bid to reach older users, those suffering from social isolation and those without internet access. A requirement to use cleaning products with a low environmental impact. A requirement to provide adequate and frequent training to staff employed by service providers.

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		Requirement to equip sanitary fittings with protection against the outflow of hot water. Requirement to identify installations in a waste water treatment plant that do not use potable water for cleaning. In the case of irrigation services, requirement to indicate: maximum increase in non-potable water use or use of mulching to prevent evaporation in the areas specified by the contracting authority or to use automatic irrigation systems specified by the contracting authority or to provide periodic water consumption reports or water demand studies within one month from the start of the contract to determine the amount of water needed to irrigate each green area or, if necessary, to plant new plants, propose their distribution taking into account water requirements, if not previously agreed. Tenderers must provide appropriate documentation to demonstrate that the above criteria are met. Water-saving urinal equipment purchase required for new and refurbished buildings. Preferential treatment of service providers using renewable energy systems. Water saving equipment required. Requirement to avoid the use of hazardous substances in cleaning and cleaning services The requirement that products for de-icing and snow removal from streets should contain less than 1% chloride or chloride ions. In this case, the tenderer must provide a material and quantity safety data sheet.	
	Construction work	Requirement of certain accessibility - height of drinking water fountains, ease of use by people with reduced mobility. Necessity to use a life cycle costing model that takes into account the purchase price, fuel consumption, and maintenance and operating costs. In the case of demolition - the need to determine how to manage hazardous materials. Requirement to indicate the costs related to the disposal of hazardous materials. The need to determine the savings obtained through the use of recycled waste materials. During construction - the need to determine the impact on the environment. Requirement to indicate the maximum available water flow rates to the wash basin / sink, regardless of the water pressure, which at the same time do not exceed the standards indicated in the document in question. Requirement to submit test results or the manufacturer's technical documentation or	The need to provide water delivery facilities that were easy to use for people with visual impairments or for people with limited mobility. The requirement for contractors to commit to promoting training opportunities for the benefit of unemployed persons when carrying out public works. A requirement for the contractor to employ and train unemployed or disadvantaged people. The need for the contractor to be responsible for recruiting, training and ensuring the employment of at least X [number specified in the tender] persons who fit into one or more of the specified categories of disadvantaged workers during the performance of this contract.

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		other appropriate evidence demonstrating that these requirements are met. The necessity to indicate the lowest maximum available water intensity in the sanitary fittings, regardless of the water pressure, which cannot be lower than the values indicated in the discussed document. The need to submit test results or the manufacturer's technical documentation or other appropriate evidence demonstrating that these requirements are met. Requirement to equip sanitary fittings with protection against the outflow of hot water. In the case of renovation and installation of sewage pipes, it is necessary to indicate the number of flushes and water consumption per 100 m of installed pipes, as well as the expected consumption of e.g. gray water and rainwater. The requirement to present a method to reduce the consumption of fresh water for flushing pipes before and after installation - by indicating the number of flushes before and after installation or the estimated water consumption as a percentage of m3 water consumption per meter of installed pipe. A requirement that at least…% of the materials used in construction / operation must be reused or recycled. Requirement to provide details of any renovation measures that need to be carried out.	
	All contract items	The need to conduct comprehensive research on the needs and expectations of customers. Require the use of sustainable, high-quality products at lower cost and facilitate access to local producers. Require supply chain details for specific product models and production sites used under the contract. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. The need to identify and validate the technical capacity to monitor work practices throughout the supply chain, including	Requirement to conduct public consultations with various stakeholders of a given activity. The necessity for the contractor performing the orders to appear as a social entrepreneur (dealing, for example, with integration in the labor market). The need to conduct comprehensive research on the needs and expectations of customers. Requirement of dialogue sessions with several third sector suppliers. Requirement of employing disabled people. The need to define guidelines for the accessibility of internet content, which include, inter alia, guidelines for blindness and visual impairment, deafness and hearing loss, learning disabilities, cognitive deficits, reduced mobility, speech disorders, photosensitivity, and combinations of these difficulties.

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		management systems and partnerships with other organizations. Requirement to include the offers of relevant experts in the evaluation panel. Joint procurement approach. Competitive dialogue as a form of awarding the contract. Defining technical standards and contractual clauses, including a guarantee of compliance in environmental issues related to waste management and management of components and noise. Reservation of the need for consultation with interested parties. The requirement to establish minimum requirements for energy and water use efficiency. Criterion requirement: sustainability, including CO2 'performance ladder' of work processes and life cycle assessment of products used. The need to use environmentally friendly cleaning methods, reduce the number of packaging, the environmental performance of the product (percentage of products complying with ISO Type I labels or equivalent) and the quality of environmental training programs. The need to implement an informal environmental management system in three steps: conduct an initial environmental review of the service, start the environmental program, make sure that steps are taken to monitor the program. Obligation to submit (every six months) data on the quantities of products used. The requirement for transport vehicles to meet the latest pollution emission standards and the need not to generate CO2 emissions in an amount exceeding the maximum levels. When determining the service life - the requirement to indicate the frequency with which the product or its part must be replaced. Defining minimum requirements for quality and durability standards. Minimum warranty requirement and spare parts availability. Determining the criteria for the use of electricity at the stage of operation. Defining criteria for fuel consumption. Require the use of low-polluting or harmless materials and products in order to improve the recyclability of the products themselves and their packaging.	Require supply chain details for specific product models and production sites used under the contract. The need for bidders to have a system to ensure that the production process of the purchased goods does not violate labor rights protected by the conventions of the International Labor Organization. Require suppliers to use supply chain traceability systems, a risk assessment process and a supplier code of conduct. Requirement to provide the concept of social criteria, including measures to ensure that their suppliers and sub-suppliers comply with the eight core ILO conventions. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. The necessity for the execution of the contract to create opportunities to achieve specific social and ethical effects. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. Require that tenderers employ disadvantaged workers for all their activities (and not just for the performance of the contract in question). Require that tenderers have an overall corporate social responsibility policy, rather than specific requirements on how to perform the contract. Specification that tenderers employ at least…% of disabled or disadvantaged workers. Requirement for the organization or its teams to have specific experience and specific expertise in dealing with societal issues relevant to the contract in question. Number and quality of apprenticeship / training opportunities created by contract execution. Tenderers must detail their attitude towards recruitment and training, provide a trial job specification for apprenticeships and describe the support structure to be implemented.

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		Requirement for products to be disassembled for recycling. Purchase of materials with recycled fibers or recycled paper etc. Defining the minimum content of recycled materials in packaging. Requirement of determining the reusability of the product. The need to indicate ways to recycle the product or its parts. Requirement to indicate information on the possible presence of harmful chemicals. Indication of product design and labeling requirements. Requirement to identify the recyclability of plastics. The need to determine the methods of sorting and disassembling products. Requirement to determine the chemical composition of plastics. The need to indicate potential contamination arising during the use of products. Requirement to replace single-use plastic products with reusable products or products made of biodegradable plastics. Requirement to supply single-use products with low environmental impact. Requirement for sanitary fittings to allow thermostatic control. Necessity for sanitary fittings to be designed with cold water inlet in the middle position. The need to equip sanitary fittings with devices that stop the flow of water after a certain time, if they are not used, (for example, motion sensors that stop the flow of water when the user leaves the sensor's range) or after a predetermined period of use (for example, time limiters that stop the flow of water) after the maximum drain time has elapsed). The product must be designed in such a way as to allow the installer to adapt the flow time to the intended use of the product. Requirement for materials used in products to come into contact with drinking water or related contaminants with such substances or materials do not cause the chemical compounds to be present in water intended for human consumption in a way that directly or indirectly reduces the protection of human health. The need for a product to be designed in such a way that its interchangeable parts can be easily replaced by the end user or a qualified professional, as appropriate.	In the context of gender equality, it is the contractor's responsibility to ensure that all direct supervisors of contracting staff complete training in aspects of gender equality in recruitment and employment, including pregnancy and maternity; menopause; sexual harassment; family-related leave such as parental leave and work-life balance etc. With regard to the minimum wage, the contractor and all subcontractors operating within the jurisdiction in which the contract is performed will comply with the specified minimum wage rates (applicable law or collective agreement) and will keep records of hours worked and wages paid. Require that all mandatory grounds for exclusion and any optional grounds that apply to the contract be adhered to on an ongoing basis during the performance of the contract, with regular updating of declarations by the responsible contractors and subcontractors.

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		When installing sanitary fixtures, the contractor must demonstrate that the installation or replacement of sanitary fixtures will be carried out by suitably qualified and experienced personnel. The contractor provides a list of people responsible for the project, indicating education and professional qualifications as well as relevant experience. Need to show how to maximize the use of rainwater and gray water. The need to submit relevant documentation. Requirement to determine a minimum percentage of rainwater and gray water sources in the total water supply. Requirement to purchase or purchase and install water heaters with a low environmental impact. The requirement to purchase irrigation systems equipped with regulation of the volume of flowing water or with adjustable time controllers (enabling the programming of the watering period) or with hygrometers. Tenderers must provide appropriate technical documentation showing that the above criteria are met. For automatic irrigation systems, the application of one or more of the following requirements: equipped with regulation of the volume of discharged water according to the zone or equipped with adjustable timers or equipped with hygrometers or, where deemed appropriate by the contracting authority, the use of recycled water . Tenderers must provide the relevant technical documentation demonstrating that the above criteria are met. Purchase of a flush toilet equipment for water efficiency for new and refurbished buildings. The requirement that the nominal total amount of flush water, irrespective of pressure, of flush toilet devices at the time of placing on the market shall not exceed… l/flush. Requirement to present the results of tests carried out in accordance with the test procedure. Domestic hot water systems, where the total amount of flush water exceeds ... liters, and toilet flushing systems, must be equipped with a water-saving mechanism. At the time of placing on the market, the reduced flush volume, irrespective of the water pressure, the flush volume, with the water saving mechanism in operation, shall not exceed… l/flush. The need to submit a document certifying the Ecolabel of the European Union for water heaters or any other appropriate ecolabel.	

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		A requirement for the flushing systems to be fitted with an adjusting mechanism so that the installer can regulate the amount of flushing water, taking into account the local conditions of the sewage system. The requirement to submit appropriate evidence, for example a declaration of the manufacturer or supplier specifying the type of solution used and its technical parameters. The need to indicate the flush volume of flushing toilet devices when placed on the market. Requirement to install non-contact flush switches (with built-in sensor) which prevent mis-actuation and ensure that the flush is only triggered when the product is actually used. The need to present or include product life cycle costs in the offer. The requirement that the nominal total quantity of flush water, irrespective of pressure, of urinal appliances at the time of placing on the market must not exceed… 1/flush. Requirement to present the results of tests carried out in accordance with the test procedure. A requirement for flushing systems to be fitted with an adjusting mechanism so that the installer can regulate the amount of flushing water taking into account the local conditions of the sewage system. The total amount of flush water after adjustment according to the installation instructions must not exceed… l/flush. Necessity that cleaning and hygiene products (ie soap) meet the criteria of the C2C "Bronze" mark or an equivalent mark.	
Information on the evidence in question		Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. The requirement to have certificates in the field of environmental management. Requirement for tenderers to have third party labels or certificates for a certain proportion (%) or all of their products. Labels or third party certification required. Necessity to submit data identifying the parts of the supply chain and the greatest potential for reducing CO2 emissions. Requirement for a company with an environmental management system to be certified by a third party. The need to submit an eco-label certificate. Requirement to submit a certificate of conformity or quality attestations.	Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. Requirement for contractors applying for the contract to submit certificates or documents attesting to the implementation of previous projects in an inclusive manner. Requirement to provide proof of the successful performance of previous contracts with similar social requirements.

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	The need to use products that have been awarded the EU Ecolabel or other label. Requirement to provide a warranty covering the repair or replacement of the product of at least… years. Necessity to submit a list of recently completed comparable projects (the number and duration of projects should be indicated by the contracting authority), a certificate of proper implementation and information on the qualifications and experience of the staff. As a rule, the requirements for the above-mentioned projects are very detailed - the need to identify at least ... projects of similar complexity, each of which should cost at least ... million euro and be implemented within the last ... years. The need to provide documents and provide a guarantee for the annual water consumption of the plant and, depending on the type of contract, by individual devices checked by summing up the water consumption of all major water-consuming facilities. Need to endorse the European Union Ecolabel or other equivalent labels. Need to provide a warranty for ... years by providing a written statement of warranty that covers repair or replacement and concludes a service contract with pick-up and return or on-site repair. The need to submit a document certifying the Ecolabel of the European Union for water heaters or any other appropriate ecolabel. Requirement to provide a list of comparable projects carried out, a certificate of satisfactory implementation and information on the qualifications and experience of the staff. In the case of rinsing efficiency - the need to submit a document certifying the European Union Ecolabel or other relevant Ecolabel. The need to provide a warranty period covering the repair or replacement of the product for a period of at least…. years. The warranty conditions must cover tightness and any valves of the product. In addition, the tenderer must ensure that the original spare parts or their equivalent are available for at least… years from the date of purchase. The need to submit a document certifying the European Union Ecolabel or other relevant ecolabel. Necessity to provide a list of recently completed comparable projects with certificates of satisfactory execution and	

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	information on the qualifications and experience of the staff. The requirement to document experience in the construction of water and sewage infrastructure, in the operation of water and sewage infrastructure or experience in environmental management at the construction site. The above-mentioned experience and technical capabilities must be documented in the form of a list of relevant projects of a similar nature and size carried out over the past ... years. On the other hand, the proof of experience in environmental management on the construction site may be EMAS and ISO 14001 certificates or equivalent certificates issued by bodies applying Community law or relevant European or international standards for certification based on environmental management standards. The need to provide an environmental management plan.	
Other criteria	Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. Tenderers will receive up to 10% of the available points for including at least one Fairtrade International certified product or an equivalent label. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified by Fairtrade International, World Fairtrade Organization or an equivalent certification system.	Tenderers will earn up to 15% of the points available, based on the quantity and quality of the employment opportunities that will be available to disadvantaged workers. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified by Fairtrade International, World Fairtrade Organization or an equivalent certification system. Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. In the case of third party certification of the ethical sources of the products supplied under the contract, points are awarded based on the percentage of the products certified with the Fairtrade mark or having an equivalent certification. Additional points can be awarded for implementing specific measures aimed at combating discrimination and promoting gender equality (e.g. staff training, work-life balance, flexible work system, etc.). In the context of ethical trade, for catering - catering - a requirement that delivered food and drink with a value of at least 5% of the annual contract price will be Fairtrade certified or equivalent.

Source: J. Piotrowska, Z. Przygodzki, own compilation.

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8.2.4. Public Circular Procurement scheme to be used for the CSS4 planning

Table 15. Award criteria for the circular system solutions in the field of plastic products.

Circular Systemic Solution: plastic [CSS4]			
Areas		**Criteria of green public procurement**	**Criteria of socially responsible public procurement**
Description of the subject matter of the contract	Supplies	The requirement to reduce deliveries by 85% (from daily deliveries to once or twice a month). Incorporating ecological products into the product range and delivering once a week with vehicles that meet the criteria for sustainable urban transport. Requirement to provide a sample (description or photo) of products or materials. The need for 75% of the materials used in the production of bags to be recycled or biodegradable. Packaging that cannot be reused must be easily separated into the different types of materials. Whenever possible, monomaterials or recyclable materials should be used. Need to produce clothing (e.g. workwear) from fair-trade organic cotton and recycled polyester. The requirement to deliver products in reusable transport packaging. In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. Need to reduce packaging and waste, for example by replacing bottled water with tap water and the choice of reusable and refillable packaging, if packaging could not be dispensed with. Requirement to replace plastic dishes with reusable dishes. Need to provide a vending machine for unpackaged hot or cold drinks that allows the use of reusable cups (e.g. porcelain or glass cups) instead of disposable cups. Setting minimum requirements for product durability, spare parts and guarantees. The need to reduce the levels of hazardous substances in electronic and electrical devices.	The need to ensure that all products supplied are manufactured in accordance with the UN Convention on the Rights of the Child and the ILO Convention No. 138 concerning Minimum Age for Admission to Employment, as well as other ILO core conventions. In the case of a contract for the supply of means of transport or related services, the need for the machinery used to be suitable for older persons and persons with disabilities. In the procurement of ICT equipment for the office, the requirement of an obligation to present specific equipment configured for use by persons with disabilities.
	Services	In the case of supplies or services, the necessity to use in…% recycled or biodegradable packaging products. The need to reduce packaging and waste, for example by replacing bottled water with tap water and choosing reusable and refillable packaging when packaging cannot be dispensed with. Requirement to replace plastic dishes with reusable dishes. Need to provide a vending machine for unpackaged hot or cold drinks that allows the	In a contract for the provision of state services - the need for the contractor to reach each of the target groups identified in the specifications and for the implementation of the specific measures included in its bid to reach older users, those suffering from social isolation and those without internet access. The requirement to provide adequate and frequent training to staff employed by service providers.

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		use of reusable cups (e.g. porcelain or glass cups) instead of disposable cups.	
	Construction work	Necessity to use a life cycle costing model that takes into account the purchase price, fuel consumption, and maintenance and operating costs. In the case of demolition - the need to determine how to manage hazardous materials. Requirement to indicate the costs related to the disposal of hazardous materials. The need to determine the savings obtained through the use of recycled waste materials. During construction - the need to determine the impact on the environment. A requirement that at least…% of the materials used in construction / operation must be reused or recycled. Requirement to provide details of any renovation measures that need to be carried out.	Require contractors to support training opportunities for unemployed people in carrying out public works. Require the contractor to hire and train unemployed or disadvantaged people. The need for the contractor to be responsible for recruitment, training and ensuring that at least X [number specified in the tender] are employed for the performance of this contract, which match at least one specific category of disadvantaged workers.
	All contract items	The need to conduct comprehensive needs research and customer expectations. Require the use of sustainable, high-quality products at lower cost and facilitate access to local producers. Require supply chain details for specific product models and production sites used under the contract. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. The need to identify and validate the technical capacity to monitor work practices throughout the supply chain, including management systems and partnerships with other organizations. Requirement to include the offers of relevant experts in the evaluation panel. Joint procurement approach. Competitive dialogue as a form of awarding the contract. Defining technical standards and contractual clauses, including a guarantee of compliance in environmental issues related to waste management and management of components and noise.	Requirement to conduct public consultations with the various stakeholders in the activity. The necessity for the contractor performing the orders to appear as a social entrepreneur (dealing, for example, with integration in the labor market). The need to conduct comprehensive research on the needs and expectations of customers. Requirement to conduct dialogue sessions with several third sector suppliers. Requirement of employing disabled people. The need to define guidelines for the accessibility of internet content, which include, inter alia, guidelines for blindness and visual impairment, deafness and hearing loss, learning disabilities, cognitive deficits, reduced mobility, speech disorders, photosensitivity, and combinations of these difficulties. Require supply chain details for specific product models and production sites used under the contract. The need for bidders to have a system to ensure that the production process of the purchased goods does not violate labor rights protected by the conventions of the International Labor Organization. Require suppliers to use supply chain traceability systems, a risk assessment process and a supplier code of conduct.

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		Reservation of the need for consultation with interested parties. The requirement to establish minimum requirements for energy and water use efficiency. Criterion requirement: sustainability, including CO2 'performance ladder' of work processes and life cycle assessment of products used. The need to use environmentally friendly cleaning methods, reduce the number of packaging, the environmental performance of the product (percentage of products complying with ISO Type I labels or equivalent) and the quality of environmental training programs. The need to implement an informal environmental management system in three steps: conduct an initial environmental review of the service, start the environmental program, make sure that steps are taken to monitor the program. Obligation to submit (every six months) data on the quantities of products used. The requirement for transport vehicles to meet the latest pollution emission standards and the need not to generate CO2 emissions in an amount exceeding the maximum levels. When determining the service life - the requirement to indicate the frequency with which the product or its part must be replaced. Defining minimum requirements for quality and durability standards. Minimum warranty requirement and spare parts availability. Determining the criteria for the use of electricity at the stage of operation. Defining criteria for fuel consumption. Require the use of low-polluting or harmless materials and products in order to improve the recyclability of the products themselves and their packaging. Requirement for products to be disassembled for recycling. Purchase of materials with recycled fibers or recycled paper etc. Defining the minimum content of recycled materials in packaging. Requirement of determining the reusability of the product. The need to indicate ways to recycle the product or its parts. Requirement to indicate information on the possible presence of harmful chemicals. Indication of product design and labeling requirements.	Requirement to provide the concept of social criteria, including measures to ensure that their suppliers and sub-suppliers comply with the eight core ILO conventions. Requirement to submit a monitoring plan to ensure that contractors are able to meet sustainability requirements. Need to consult relevant stakeholders. The requirement for the contractor to cooperate with other entities of a similar nature, who implement sustainable public procurement. The necessity for the execution of the contract to create opportunities to achieve specific social and ethical effects. Disclaimer of the obligation to conduct follow-up meetings with unsuccessful bidders after the tender to inform them of the reasons why their proposal has proved insufficient. Requirement that tenderers employ disadvantaged workers as part of all its activities (and not only for the implementation of a given order). Require that tenderers have an overall corporate social responsibility policy, rather than specific requirements on how to perform the contract. Specification that tenderers employ at least…% of disabled or disadvantaged workers. Requirement for the organization or its teams to have specific experience and specific expertise in dealing with societal issues relevant to the contract in question. Number and quality of apprenticeship / training opportunities created by contract execution. Tenderers must detail their attitude towards recruitment and training, provide a trial job specification for apprenticeships and describe the support structure to be implemented. In the context of gender equality, it is the contractor's responsibility to ensure that all direct supervisors of contracting staff complete training in gender equality in recruitment and employment, including pregnancy and motherhood; menopause; sexual harassment; family-related leave such as parental leave and work-life balance etc. With regard to the minimum wage, the contractor and all subcontractors

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		Requirement to identify the recyclability of plastics. The need to determine the methods of sorting and disassembling products. Requirement to determine the chemical composition of plastics. The need to indicate potential contamination arising during the use of products. Requirement to replace single-use plastic products with reusable products or products made of biodegradable plastics. Necessity to use products with…% less microplastics. Requirement to supply single-use products with low environmental impact. Require the use of compostable rubbish bags awarded for bio-waste. Requirement to purchase products delivered in compostable, reusable or biodegradable packaging. Description of the reusable container return system required.	operating within the jurisdiction in which the contract is performed will comply with the specified minimum wage rates (applicable law or collective agreement) and will keep records of hours worked and wages paid. Require that all mandatory grounds for exclusion and any optional grounds that apply to the contract be adhered to on an ongoing basis during the performance of the contract, with regular updating of declarations by the responsible contractors and subcontractors.
Information on the evidence in question		Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. The requirement to have certificates in the field of environmental management. Requirement for tenderers to have third party labels or certificates for a certain proportion (%) or all of their products. Labels or third party certification required. Necessity to submit data identifying the parts of the supply chain and the greatest potential for reducing CO2 emissions. Requirement for a company with an environmental management system to be certified by a third party. The need to submit an eco-label certificate. Requirement to submit a certificate of conformity or quality attestations. The need to use products that have been awarded the EU Ecolabel or other label. Requirement to provide a warranty covering the repair or replacement of the product of at least… years. Necessity to submit a list of recently completed comparable projects (the number and duration of projects should be indicated by the contracting authority), a certificate of proper implementation and information on the qualifications and experience of the staff. As a rule, the requirements for the above-mentioned projects are very detailed - the need to identify	Requirement to conduct market studies that assessed market readiness, supply chain transparency and the label potential of a given sector. Requirement for contractors applying for the contract to submit certificates or documents attesting to the implementation of previous projects in an inclusive manner. Requirement to provide proof of the successful performance of previous contracts with similar social requirements.

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	at least ... projects of similar complexity, each of which should cost at least ... million euro and be implemented within the last ... years. Need to endorse the European Union Ecolabel or other equivalent labels. Need to provide a warranty for ... years by providing a written statement of warranty that covers repair or replacement and concludes a service contract with pick-up and return or on-site repair. Requirement to provide a list of comparable projects carried out, a certificate of satisfactory implementation and information on the qualifications and experience of the staff. The need to submit a document certifying the European Union Ecolabel or other relevant ecolabel.	
Other criteria	Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. Tenderers will receive up to 10% of the available points for including at least one Fairtrade International certified product or an equivalent label. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified under Fairtrade International, World Fairtrade Organization or an equivalent certification system.	Tenderers will earn up to 15% of available points based on the quantity and quality of employment opportunities that will be available to employees located in a particularly disadvantaged situation. 5% of the award criteria were reserved for additional social and environmental aspects such as the presence of raw materials certified under Fairtrade International, World Fairtrade Organization or an equivalent certification system. Awarding additional points to tenderers who agree to donate to a charity or decide to support non-award related projects. In the case of third party certification of the ethical sources of the products supplied under the contract, points are awarded based on the percentage of the products certified with the Fairtrade mark or having an equivalent certification. Additional points can be awarded for implementing specific measures aimed at combating discrimination and promoting gender equality (e.g. staff training, work-life balance, flexible work system, etc.). In the context of ethical commerce, catering orders require that food be delivered and beverages with a value of at least 5% of the annual contract price will be Fairtrade certified or equivalent.

Source: J. Piotrowska, Z. Przygodzki, own compilation.

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9. Interoperability of CRC databases

9.1. Methodology

9.1.1 Methods of research

The methodology of research concerning databases is based on the desk research method. The aim of the research was: identification of databases containing information related to the circular economy in the region, in particular in the area of CSS; identification of gaps in database characteristics; and identification of the level of database interoperability at the technical level.

The first step of the study needs to use the internet to explore the availability of the databases where we can find the public databases connected with the project's goals. The second database type was the elements the team members obtained from external institutions based on inquiries for access to publicly shared data. Researchers also got databases from project partners. Exploratory research ended in March 2022, and after this, there was the possibility to start the next stage of research based on descriptive elements of databases. At this stage, the team members prepared the characteristics of databases connected with some of their features.

The next step in the research was identifying database gaps. After this stage of research researchers identifying their potential interoperability. The interoperability of databases has been defined essentially. It consisted of identifying possible database features that may be an element enabling the connection of databases from different sources. This stage was connected with the thematic analysis of databases (Bianchini et al., 2016).

The team members looking for some feature which can be connected in two or more databases to identify the technical level of interoperability of the databases. The team members analysing the databases look for some connection to the next steps of Frontsh1p project implementation where the team can use the information of databases. At each stage of the research, an expert approach based on the acquired scientific and practical knowledge was applied.

9.1.2. State of the art

The term "interoperability" has many meanings, first of all it concerns the possibility of easy transition from one IT system to another, for example thanks to the mutual sharing of functions, data exchange standards. In this paper, interoperability covered databases from various sources, in terms of the evaluation of file formats as well as the possibility of their acquisition, exchange, conversion, sharing, and possibly combining them into one system. In the case of geospatial data, the issue of interoperability is crucial as the data comes from many sources (Sondheim et al., 1999), has different formats and requires knowledge of their representation (spatial and temporal scale, graphic data format and attributes).

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A very important legal act on a European scale is the INSPIRE directive. Although it concerns the availability, quality, organisation, accessibility and sharing of spatial information. However, it imposes an obligation on the administration authorities, keeping public registers containing spatial data sets, to undertake technical and organizational actions in order to enable the possibility of combining and joint use (interoperability) of data. According to the INSPIRE directive interoperability "means the possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the data sets and services is enhanced"(INSPIRE 2007, p.5).

Interoperability is not a purely technical matter. In fact, it is a problem affecting the interactions of entities that produce, collect and manage data at different levels: At the organizational level, it covers business goals and data-related processes within the institution At the semantic level, it relates to the meaning of the exchanged digital resource, including their contextual information At the technical level, it concerns the heterogeneity of technology used by institutions in related processes, including communication channels and information exchanged through them (Pagano et al., 2013; Masud, 2020).

Data interoperability cannot be equated with data integration, which aims to synthesize data from different, independent sources into a unified schema. The data interoperability requires the implementation of both data integration and exchange, as well as enabling the effective use of the shared data. Interoperability therefore involves the matching of schemas used in the creation of data by different institutions (Erhard, Bernstein, 2001; Pagano et al., 2013).

"Based on the limited relevant literature, the concept of fitness for use from the quality literature, and our experiences with data consumers, we propose a preliminary conceptual framework for data quality that includes the following aspects:

- The data must be accessible to the data consumer. For example, the consumer knows how to retrieve the data.
- The consumer must be able to interpret the data. For example, the data are not represented in a foreign language.
- The data must be relevant to the consumer. For example, data are relevant and timely for use by the data consumer in the decision-making process.
- The consumer must find the data accurate. For example, the data are correct, objective and come from reputable sources (Wang, Strong, 1996, p.11).

9.2. Results

9.2.1. Basic information of CRC databases

The analysis of the databases shows that in the formal research stage, there are data connected with three groups analysed in the Frontsh1p project. These entities are companies, public administration institutions and academia. The researchers identified ten databases. Statistics Poland is the owner of three of them. Two of them came from the marshal's office in Lodz, but each marshal office in Poland has got the same bases. The Ministry of Climate and Environment is the owner of two databases too. Other owners of databases connected with the goals of the

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project are The Head Office of Geodesy and Cartography, the Ministry for Education and Science and The Patent Office of the Republic of Poland (Tab. 16).

Table 16. Databases identified in the research

No	Database name	Shortcut name	Lead authority
1	Regional Fund for Environmental Protection and Water Management in Lodz	WFOŚiGW	Marshall Office
3	National Science Centre Poland	NCN	Ministry for Education and Science
4	Waste Catalogue	WC	Ministry of Climate and Environment
5	Database on Products, Packaging and Waste Management	BDO	Ministry of Climate and Environment
6	Registry of an Entities of National Economy	REGON	Statistics Poland
7	Local Data Bank	BDL	Statistics Poland
8	National Official Register of the Territorial Division of the Country	TERYT	Statistics Poland
9	The Database of Topographic Objects	BDOT10k	The Head Office of Geodesy and Cartography
10	Intellectual Property Rights - e-Search	IPR	The Patent Office of the Republic of Poland

Source: own work.

Only one database contains the spatial data. In the case of the other databases identified in the project, it allows connecting data with the geolocalisation with accuracy to the commune level. Some of the databases have got greater precision, for example, to identify the university or company in the commune space (REGON, IPR, NCN, RPO).

9.2.2. CRC databases characteristics

The expert analysis allows showing differences between used databases. The first step of research allows presenting the method for data access. Many of the analysed databases (9) are available over the internet. In the case of the Regional Fund for Environmental Protection, the data is available upon request in accordance with the Act on Access to Public Information. The highest data formats are available in databases led by Statistics Poland, The Head Office of Geodesy and Cartography and The Patent Office of the Republic of Poland (Table 17).

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The second assessed feature was the possibility of connection with other databases on the list. The interoperability was identified between the databases of Statistics Poland and The Head Office of Geodesy and Cartography. Statistics Poland is allowed to connect its databases based on the territorial register.

The last element of the database description was connected with the competencies of potential users. Readers must know that the low level is the desired level for publicly available data. The low level was sorted out to the BDO database available via the web because this database is simple in management for the user, but there is a lack of information. The low level of competence of end-user is also required for databases: REGON and BDL, led by Statistics Poland.

The high competencies of end-user are required in the case of BDOT10k, IPR and RPO databases. BDOT10k is connected with downloading data and using specialized software for data management in SHP, GML formats and web map service (WMS). IPR database users need to know the database structure to use API because the web database only allows primary information access. The same situation is connected with the RPO database with access via the web, but the data from Marshall Office have a high level of complexity.

Table 17. Features of databases

No	Shortcut name	Source	Features	
			Type of access connected with file format	User competition level (low, medium, high)
1	WFOŚiGW	https://www.wfosigw.lodz.pl/	Only via public access	medium
2	RPO	https://rpo.lodzkie.pl	web, public access	high
3	NCN	https://www.ncn.gov.pl/	web, public access	medium
4	WC	http://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20140001923/O/D20141923.pdf	web, pdf	medium
5	BDO	https://bdo.mos.gov.pl/	web	low
6	REGON	https://wyszukiwarkaregon.stat.gov.pl	web, API	low
7	BDL	https://bdl.stat.gov.pl/bdl/start	web, multidimentional table, API	low
8	TERYT	https://eteryt.stat.gov.pl/eTeryt/rejestr_teryt/aktualnosci/aktualnosci.aspx	web, API	medium
9	BDOT10k	https://www.geoportal.gov.pl	web, WMS, GML, SHP	high
10	IPR	https://uprp.gov.pl/pl	web, API	high

Source: own work.

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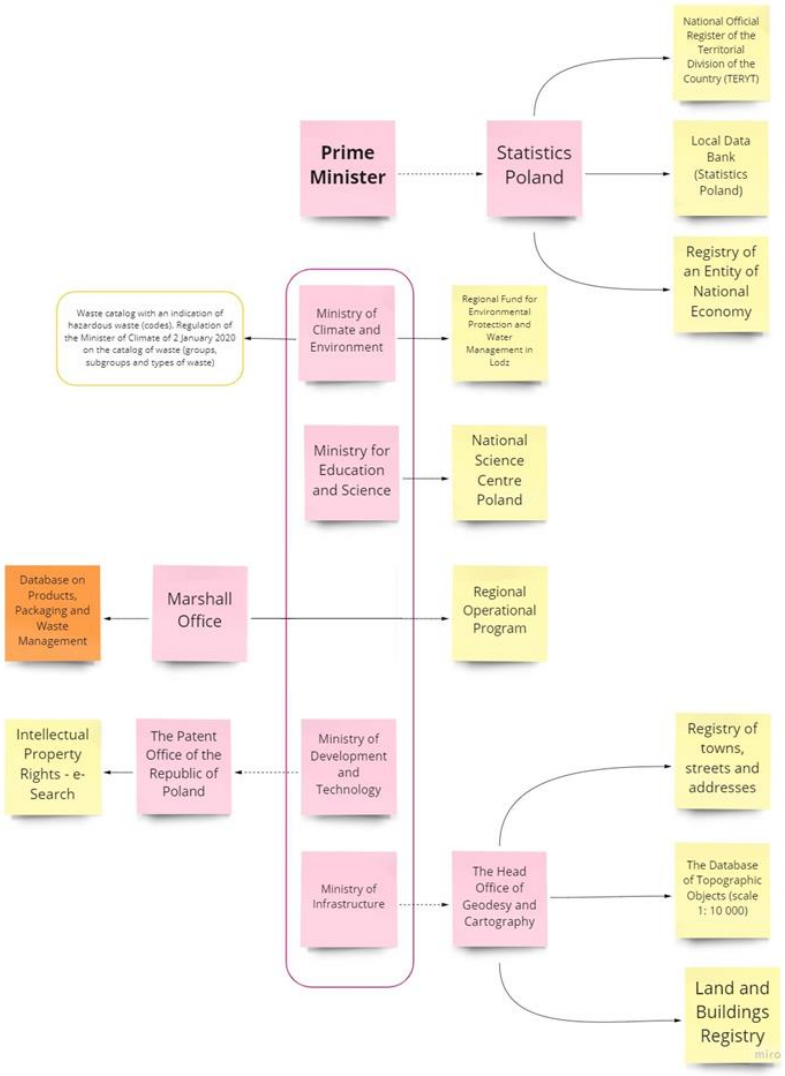
The main information is that a simple data-sharing approach characterizes all databases available via the web. Using the other type of access to the same data allows the use of more complex data.

9.2.3. Gaps identification of CRC databases

The fundamental gap in the databases in Poland and the Lodzkie Region is the lack of interoperability between different databases. Another gap is that many data available in the institution are treated as a part of the General Data Protection Regulation (GDPR). It causes data that could be spatially referenced to be stripped of this feature. Another database gap is that many of these data are available only at the national level. Data are produced at the local level but are transferred to databases at the central level. It causes their availability to be lower for every local and regional actor. Centralisation of database management under the prime minister's control shows that the data are far from users who need them to use in the circular economy (Figure 32).

Figure 32. Database owners and its centralisation



Source: own work using Miro software.

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The significant gap in the databases available in the circular economy field is the lack of information about the waste code connected with the Waste Catalogue. It shows that there is a gap associated with the identification of resource suppliers for CSS. The second gap is the lack of a glossary that could help identify projects connected with the circular economy in scientific institutions and regional operational programs. In the research, we recognise that web databases are simply built and that identifying some features is a time-eater, which is not acceptable in the case of entrepreneurs. Another database gap is their topicality because only spatial databases are constantly updated.

9.2.4. Interoperability of CRC databases

Under research, there is one main conclusion made. There is a need for the interoperability of databases on each level and in each institution. There is a need to present potential bind fields in geodatabases. One of the fields may be the tax identification number or location data in circular territorial clusters. It must be known that this information could be used in other databases with a different scope of thematic data (Lacayo et al., 2021).
The identifying connection is present within the same institution, and the strongest links between the databases have been identified in Statistics Poland. Another connection in technical interoperability is a linkage between geodetic databases and statistical databases (Table 18). The statistical databases are connected with Registry of an Entities of National Economy too.

Table 18. Connection of databases

No	Shortcut name	Source	Connection with other databases
1	WFOŚiGW	https://www.wfosigw.lodz.pl/	Lack of direct connection
2	RPO	https://rpo.lodzkie.pl	Lack of direct connection
3	NCN	https://www.ncn.gov.pl/	Lack of direct connection
4	WC	http://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20140001923/O/D20141923.pdf	Lack of direct connection
5	BDO	https://bdo.mos.gov.pl/	Lack of direct connection
6	REGON	https://wyszukiwarkaregon.stat.gov.pl	TERYT
7	BDL	https://bdl.stat.gov.pl/bdl/start	TERYT, BDOT10k
8	TERYT	https://eteryt.stat.gov.pl/eTeryt/rejestr_teryt/aktualnosci/aktualnosci.aspx	Registry of an Entities of National Economy
9	BDOT10k	https://www.geoportal.gov.pl	TERYT
10	IPR	https://uprp.gov.pl/pl	Lack of direct connection

Source: own work.

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Another way to build technical interoperability of databases is to create spatial databases related to the territory and allow for a different level of data aggregation. Such databases by spatial reference make it easy to identify available resources, both with respect to circular systemic solutions. Interoperable solutions in a circular territorial cluster will shorten the supply chains between producers by building knowledge in reusable waste production. Such an approach will promote sustainable development in line with the sustainable development goals guidelines.

9.3. Conclusion

To ensure data interoperability, the databases containing these data should operate based on interinstitutional specifications - data schemas. There is a need for a common framework to identify information stored in the databases uniquely. A solution may be using identifiers within national or international systems to ensure their mutual data interoperability. It is important to provide metadata containing information about key attributes, the temporal dimension of the data and its timeliness. It should be a standard to establish reference sets and force their use when creating public databases. Such an orderly operation can lead to harmonizing data sets, enabling integration and cooperation. Good examples are activities related to the implementation of the INSPIRE Directive, which led to the creation of a European infrastructure for spatial information and facilitated access to spatial data.

Existing data needs to be harmonized as a large amount of information has been gathered in the databases identified in the research. Harmonization may be carried out through integration with REGON and TERYT databases, which could be possible based on address data.

When working with data on waste management, it is important to be aware of the quality of the available data - e.g. their timeliness, attributes and schemes. The obtained data should be comparable n not only for the territory of Poland but with data from various EU countries.

The challenge for database interoperability is the need to build open-source resources. This leads to the possibility of use in the scientific community and entrepreneurs. It also results from the interpretation of the provisions of the GDPR, which significantly limit access to data.

In the case of all CSS, spatial databases will allow the identification of components of supply chains allowed for refurbishing, reusing, recycling and the next step of the development of CRC energy recovery. Geospatial databases allow for identifying the land use which are connected with CSS2 and CSS3 in the scope of building-up new multipurpose farms in the regions.

Some databases, after excluding certain requirements resulting from the GDPR Act, allow you to generate knowledge resources about water reuse and recycling clean or grey water (Gross et al., 2015; Kobayashi et al., 2020; Haldar et al., 2021). In all cases, databases allow for identifying materials constituting a production factor, mainly when the databases are part of an open geoportal filled in by local actors (Nurdin et al. , 2021; Lalović, Živković, 2019).

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10. Territorial compass for institutional cooperation in CRC

10.1. Methodology

Coherence and synergy can be considered at the level of challenges and their compatibility with local policy goals. This is a basic condition for including an integrated approach in local development processes. The implementation of the circular economy requires the involvement of all four groups of partners responsible for creating CRC: company, academy, society and government. This involvement requires monitoring and coordination. Such coordination should be the domain of public authorities at both the local and regional levels. Integration of activities induces synergy processes and is therefore a function of the speed of change and the dynamics of regional development processes. This element is particularly important when talking about systemic changes - the evolution of a free market economy operating under a linear production model into a circular economy. However, it should be highlighted that integration of activities on a regional scale (CRC) does not necessarily mean direct cooperation between partners. It is most important that the activities of individual partners affect the resolution of the challenges of the other partners to the greatest extent possible. In other words, partners do not have to be directly bound to each other by formal agreements - it is important that "the sailors in the boat row in the same direction and with solidarity commitment." Hence the importance of the study, which aims to identify the scope of impact of the projects implemented by individual CRC stakeholders on the realization of the challenges and objectives of the projects of the other regional partners. In other words, the goal of the study is to identify the extent of the mutual impact of the projects implemented:

- first by Company for the purposes of the activities of the other CRC partners (academy, society and government);
- secondly by Academy for the purposes of the activities of the other CRC partners (company, society and government)
- third by Government for the purposes of the activities of the other CRC partners (company, academy, society)
- fourth Society for the purposes of the activities of the other CRC partners (company, academy, and government)

The Leopold Matrix method was used to achieve this goal. This method, in a modified version, is recommended by the Council of Europe for monitoring the European Heritage Strategy for the 21st Century. It has been adapted to audit the degree of the synergy of projects. The method makes it possible to assess the level of relations between regional partners as measured by the degree of the synergy of their projects. In Frontsh1p, this method was modified to identify the levels of integration between 4 sets of partners. The level of these relationships

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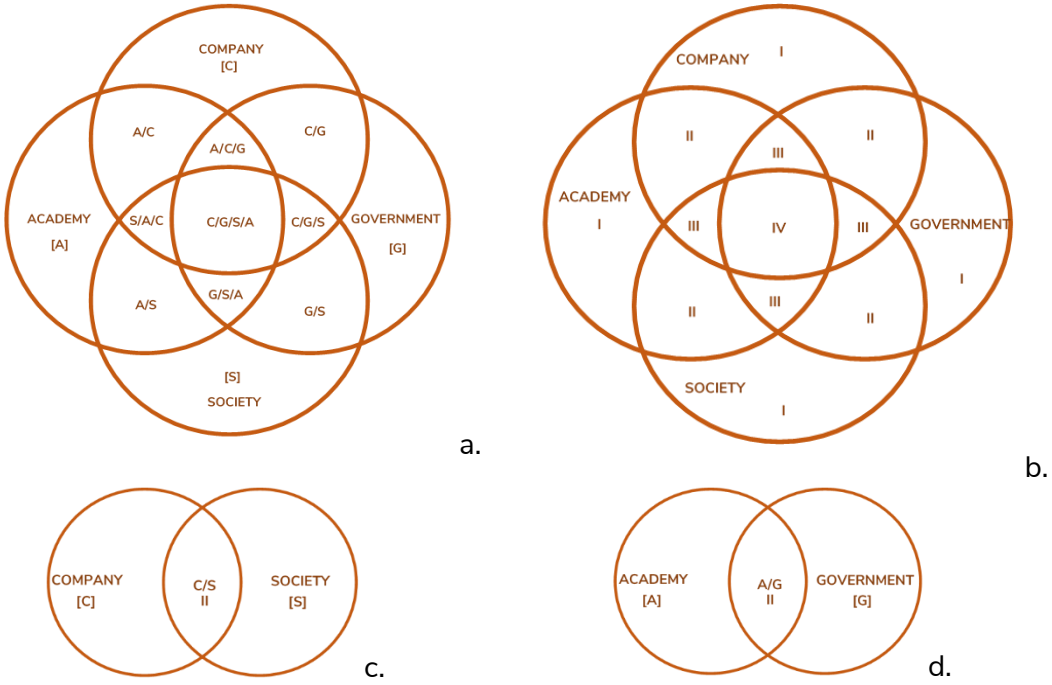
can be identified at several levels depending on the number of partner groups. In the case of CRC, there are 4 groups, so 4 levels of relationships were identified (Fig. 28):

- I: C, G, S, A.
- II. AC, CG, AS, GS, SC, AG.
- III. ACG, CGS, GSA, SAC
- IV. CGSA

The sets of relations were determined according to the logic of the Venn diagram (Fig. 33) The Venn diagram in its classical form applies to 3-element sets. However, in the case of 4-element sets, two 2-element sets are difficult to see. Therefore, when analyzing 4 sets, additional figures were prepared: c. and d.

Figure 33. Graphical interpretation of integration of activities between CRC partners: a,c,d.: subjective scope of integration; b,c,d.: levels of integration



Source: own compilation

Stages of study realization:

1. Identification of projects implemented by all stakeholders in terms of the key objectives of their implementation and the main indicators for measuring results. The study analyzed: 187 projects (Tab. 19).

Table 19. Characteristics of project sources selected for synergistic effects analyses at CRC

Database type (data source) / data selection method	Stakeholders	Number of projects selected for analysis
National Science Centre Poland, NCN (period: 2011-2021; Spatial scope: Poland - interuniversity projects of at least national scope. Population: 21432 projects/CE Keywords.	Company	28

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Regional Operational Programme, RPO[2] (period: 2014-2021; Spatial scope: Lodzkie region. Population: 3410 projects /Keywords for CE. Primary data on Local Initiatives obtained from a **diagnostic survey** from all local government units - potential CRC members (80 respondents): 99 projects Primary data on Citizen Budgets obtained from a **diagnostic survey** from all local government units - potential CRC members: 80 respondents: 26 projects.	Academy	28
	Society	99
	Government	32

Source: own compilation

2. Prepare a matrix involving the transposition of objectives and indicators. The order of objectives and indicators corresponds in the matrix, that is, the same order of stakeholders (company (C), government (G), society (S) and academy (A)) was maintained when entering the objectives and indicators. The superscript "I" added in the formulas informs that the specified set relates to indicators. The absence of an index means that the defined set relates to the objectives of the identified projects. (Tab. 17.)
3. Evaluate the relationship between each objective and indicator by determining the direction of this impact. The impact could be positive (1), negative (-1) or neutral (0). Neutral impact means that the indicator does not affect the objective or the indicator does not relate to the objective. The survey did not identify any projects with negative (inhibitory) impacts.
4. Summing up the scores in the fields of the relations of the objectives identified in each stakeholder group and the relevant indicator groups according to the formulas (Fig. 34).

[2] From the base of projects implemented under the Regional Operational Program of the Łódź Region for 2014-2020, on the basis of analysis of documentation, including Detailed Descriptions of Priority Axes, activities, directly and indirectly, related to the implementation of CE were selected:
a. Priority Axis: I Research, development and commercialization of knowledge: Activity I.1 Development of research and innovation infrastructure; Activity I.2 Investments of enterprises in research and innovation.
b. Priority axis II Innovative and competitive economy: Activity II.2 Internationalization of enterprises (sub-activities 2.2.1, 2.3.1, 2.3.2).
c. Priority axis IV Low-carbon economy: Activity VI Revitalization and endogenous potential of the region.
The summary was prepared: based on data from the SL 2014 Central Information and Communication System as of 03.01.2021; filtering of projects was done by sub-measure code.

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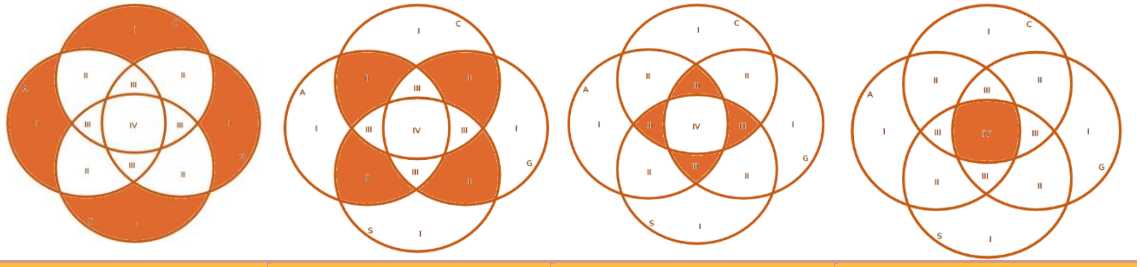
Figure 34. Types of interactions between projects and indicators



[I] intra-sectoral interaction (specific impact)	[II] cross-sectoral interaction (2.level)	[III] cross-sectoral interaction (3.level)	[IV] Integration
Formula: CC^I, GG^I, SS^I, AA^I	**Formula**: $(AC^I+CA^I)/2=AC^I/CA^I$ $(CG^I+GC^I)/2=CG^I/GC^I$ $(GS^I+SG^I)/2=GS^I/SG^I$ $(AS^I+SA^I)/2= AS^I/SA^I$ $(SC^I+CS^I)/2=SC^I/SA^I$ $(AG^I+GA^I)/2=AG^I/GA^I$	**Formula**: $[(AC^I \cap AG^I+CA^I \cap CG^I+GA^I \cap GC^I)+(AG^I \cap CG^I+CA^I \cap GA^I+AC^I \cap GC^I)]/3= A^nC^nG^n$ $[(CG^I \cap CS^I+GC^I \cap GS^I+SC^I \cap SG^I)+(CS^IGS^I+GC^I \cap SC^I+CG^I \cap SG^I)]/3= C^nG^nS^n$ $[(GS^I \cap GA^I+SG^I \cap SA^I+AG^I \cap AS^I)+(GS^I \cap AS^I+SG^I \cap AG^I+GA^I \cap SA^I)]/3= G^nS^nA^n$ $(SA^I \cap SC^I+AS^I \cap AC^I+CS^I \cap CA^I)+(SA^I \cap CA^I+AS^I \cap CS^I+AC^I \cap SC^I)]/3= S^nA^nC^n$	**Formula**: $[(CC^I+GG^I+SS^I+AA^I)/4+(AC^I/CA^I+CG^I/GC^I+GS^I/SG^I+AS^I/SA^I+SC^I/SA^I+AG^I/GA^I)/4+(A^nC^nG^n+C^nG^nS^n+G^nS^nA^n+S^nA^nC^n)/4]/3$
synthetic index: $(CC^I+GG^I+SS^I+AA^I)/4$	synthetic index: $(AC^I/CA^I+CG^I/GC^I+GS^I/SG^I+AS^I/SA^I+SC^I/SA^I+AG^I/GA^I)/4$	synthetic index: $A^nC^nG^n+C^nG^nS^n+G^nS^nA^n+S^nA^nC^n)/4$	synthetic index: as above

The superscript "I" added in the formulas informs that the specified set relates to indicators
Source: own compilation

Interpretation of the results of the different types of impacts:

1. **Intra-sectoral interaction (specific impact)** (I; designations: CC, GG, SS, and AA) signify the conventional nature of the relationship (impacts) and represent the effectiveness of each stakeholder group separately in implementing their own projects directly and achieving their goals. These projects do not correlate with the indicators of other partners' projects. The interpretation of the results in this regard is as follows:
   - CC: effectiveness of activities implemented in the Company group in solving challenges identified by the Company.
   - GG: effectiveness of activities implemented in the Government group in solving challenges identified by the Government.
   - SS: effectiveness of activities implemented in the Society group in solving challenges identified by Society.
   - AA: effectiveness of activities implemented in the Academy group in solving challenges identified by the Academy.
   - Choosing this path of activities is very effective in achieving the goals and results within the selected stakeholder group C, G, S or A

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2. **Cross-sectoral interaction (2.level)** (II; designations: CG; GC; GS; SG; SA; AS; GA; AG) Connections of cross-sectoral impact allow the assessment of synergies between two sets of partners. They can be interpreted as follows:
   - AC: the effectiveness of the activities carried out in the Academy group in solving the challenges of the Company, and vice versa.
   - **CG**: The effectiveness of the activities carried out in the Company group in solving Government challenges and vice versa.
   - **GS**: the effectiveness of activities carried out in the Government group in solving Society challenges and vice versa.
   - **AS**: the effectiveness of activities carried out in the Academy group in solving Society challenges and vice versa.
   - **CS:** the effectiveness of activities implemented in the Company group in solving Society challenges and vice versa.
   - **AG**: effectiveness of activities carried out in the Academy group in solving challenges related to Government and vice versa.

3. **Cross-sectoral interaction (3.level)** (III; designations: ACG, GSC, ASG, ACS) should be interpreted appropriately for level two, assuming that in this case three sets of stakeholders are being analyzed:
   - ACG**:** synergies of goals and deliverables among sector stakeholders: ACG.
   - GSC: synergies of goals and deliverables among sector stakeholders: GSC.
   - ASG**:** synergies of goals and deliverables between sector stakeholders: ASG.
   - ACS**:** synergies of goals and deliverables between sector stakeholders: ACS.

4. **Integration** (IV; designaion: CGSA) should be interpreted so that projects undertaken by all partners mutually reinforce the achievement of their desired deliverables.

10.2. Results

Analysis of the synergy of aims and results of CRC stakeholder activities in the Lodzkie Region at the beginning allows concluding that projects have been identified in each group that strengthens CE building. However, the sum of such projects is small: 187 projects, implemented in the period 2014-2021 (Company and Academy) and 2019-2021 (Society, Governance). Thus, one can speak of a low level of project involvement of CRC stakeholders in Lodzkie Region in strengthening CE.

The number of projects that strengthen CE building varies due to the availability of information in the databases and the size of the projects. Nevertheless, it can be noted that in the Company (28) and Academy (28) groups, the selected projects directly relate to activities involving green technologies and are related to environmental protection in various aspects. On the other hand, in the Society (99) and Governance (32) groups, the majority of projects involve activities indirectly related to strengthening CE. Most often, these are projects that strengthen the sense of responsibility, level of participation and social activation, sharing of things, services or reduction of consumption. Less often, these projects involve processes related to recycling and reusing things. The three times higher number of projects in the Society group is due to their fragmentation and small scale of activities. Nevertheless, projects of this type are

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characteristic of activities undertaken by residents and local community groups. To sum up, projects undertaken directly by local authorities (Governance) and the local community (Society) are rarely about empowerment or inclusion in the Circular Value Chain.
Analyzing the findings on the interactions between the regional partners' project activities, it is important to note the relatively large variation in the average ratings for each impact category (Table 20).

Table 20. Average ratings of synergistic interactions between stakeholder groups

Level of integration	Average rating
intra-sectoral interaction (specific impact)	2563
cross-sectoral interaction (2.level)	577,25
cross-sectoral interaction (3.level)	1381
Integration	1507

Source: own compilation

The vast majority of implemented projects by CRC stakeholders are sectoral (2563). These projects do not affect the achievement of results by other partners. They are important from the point of view of strengthening the sector's internal competitiveness, but their synergistic effects on the local and regional environment are marginal. Optimally, the quantities identifying the different levels of impact should be high and balanced. The lack of this level of sustainability is especially underscored by the fact that the assessment of interaction impacts is five times lower (577.25), concerning partnership relations between two groups of stakeholders. It is difficult to speak of a sustainable level, nevertheless, it is worth noting that there were cross-sectoral projects in the region that effectively achieved their goals and contributed to the achievement of results in three groups (1,381) or all stakeholder groups (1,507).
The most important image illustrating the scope and needs for coordination of integration activities is given by the analysis at the detailed level (Fig. 30.). This diagnosis indicates the weaknesses and strengths of particular partnerships between regional stakeholders. It is also important to remember that it is not the existence of formal partnerships. Often, in this case, the strength of synergistic effects depends on the level of awareness and tacit knowledge in the CRC.

In intra-sectoral interaction, the highest level of self-management of development processes within the sector is observed in the Society group (8458). On the one hand, this is good information. On the other hand, the height of this indicator can be interpreted as a closure of the sector to interactions with other sectors. This conclusion is supported, in particular, by the values of second-level interactions between Society and Company (133) and Society and Academy (8.5), which are practically non-existent. The convergence of the Society sector's internal goals is mainly due to the effect of copying the ideas of neighbours and the specificity and monoculture of non-governmental institutions at the local level. In the Government and Company sectors, the ratios are significantly lower, respectively: 614, 837. Nevertheless, it can be considered that these values are at the average level. In this case, the interaction between the objectives of the projects was determined primarily by the availability of project funding sources. It is about the orientation of the subject matter of the projects by the terms of the grants. The lowest value of the intra-sectoral interaction index is identified in the Academy sector (343). This is related, on the one hand, to the low budget 0for R&D in Poland, sectoral closure and individualism determined by the low degree of territorialization of academic sector entities in the Lodzkie Region. Sectoral closure usually means the implementation of partnership projects but based on industry similarity of partners, rarely spatial proximity.

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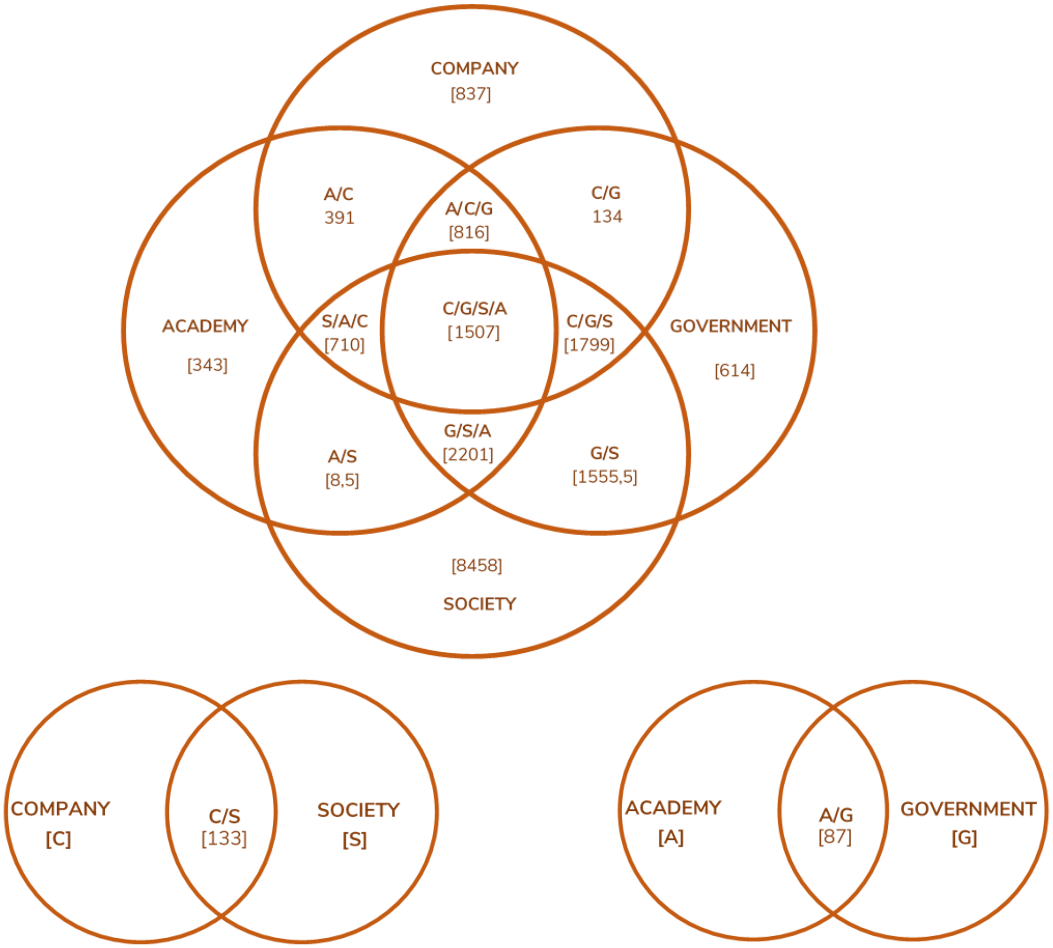
Figure 35. Scope and levels of synergistic effects among CRC stakeholders in Lodzkie Region.



Source: own compilation

The situation at the second level interaction is also a challenge. There is a lack of cross-sectoral sustainability. On the one hand, four areas of neglect can be identified: Academy/Society (8.5), Academy/Government (87), Company/Society (133) and Company/Government (134). The processes of synergistic effects between these areas hardly occur. On the other hand, one can see a positive picture of project relations between the Academy/Company sectors (391). This is not an indicator of a particularly high value, but nevertheless, this scope of cooperation is particularly desirable and difficult in Polish conditions, so it is worth highlighting. On the other hand, the value of the indicator of relations between sectors is high: Government/Society (1555.5). This means that local authorities influence the behaviour of residents to a large extent and can carry out coordination activities with great effectiveness.

Particular attention should be paid to the Third level of interaction and integrated impacts. It can be seen that in projects implemented in a group of Government or realizing its goals, the interaction has a balanced and relatively high level (from 1507 to 2201). In another case, for example, in the sets: Society/Academy/Company (710) the value is less than half. We can conclude that the goals of projects that coincide with local or regional development policies have a significantly higher potential for synergistic effects. This also means that an extremely

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important role has to be played by local and regional Government in the transformation of the traditional economy to a circular economy in the Lodzkie Region.

10.3. Conclusion

In Lodzkie Region in particular in the CRC, care should be taken to strengthen the synergies obtained through public, private and social investments. Projects undertaken by all regional partners, above all, should be implemented far more often in scopes related to the formation of CE. This effect can be achieved not only by increasing investment budgets but, above all, by targeting resources more precisely to the goals of CE implementation. In this regard, it is also worth emphasizing the importance of Green Public Procurement, which is used to a minimal extent. In contrast, the potential of targeted public spending is high. Analyses of the levels of integration activities strengthening the transition of CE to CRC allow us to formulate some key conclusions:

- Low level of project involvement of CRC stakeholders in Lodzkie Region in strengthening CE
- Projects undertaken directly by the Government and the local community (Society) are rarely focused on empowerment or inclusion in the Circular Value Chain.
- In the territory of CRC in Lodzkie Region, CE strengthening projects are mainly sectoral
- Very low level of synergistic effects caused by the activity of CRC partners inside the Academy sector.
- 2nd level interactions are particularly profitable between local authorities and the local community resulting in the ability to efficiently coordinate behaviour and conduct local policies oriented toward CE development
- Almost no interaction between project objectives and their results between Academy/Society and a very low level of such interactions between Academy/Government, Company/Society and Company/Government.
- The coordinating role of local and regional governments has a legitimate and durable basis in local institutions and strategic documents defining elements of development policy.
- At the level of multi-sector interaction, there is a relatively high and sustainable level of relationship between the projects implemented by the various stakeholders and the results of these projects.
- The level of inclusion of the Academy sector in project interactions at the multisectoral level should be strengthened.

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